



**TAME-POWER**

TRONICO



User Manual  
**CISO SERIES - Isolated**

DCDC CONVERTER USER MANUAL  
CISO SERIES - Isolated

Product Ref: CISO-DCDC-800V-XXV-YYKW-00



# DCDC CONVERTER USER MANUAL

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For any further information, please refer to Tame-Power applicable General Terms and Conditions of Sales.

## Warning

This manual contains installation guidelines, operational steps, and product specifications. The information within may be updated without prior notice. It is intended for qualified individuals with fundamental understanding of electricity and safety practices.

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# 1 USING THIS DOCUMENT

## 1.1 Prologue

Please read the entire document before any installation, manipulation or use of your device in order to protect the safety of the users.

The information given in this document must be followed. **TRONICO** cannot be held responsible if instructions of the present document are not observed.

This documentation provides the reader an overview of all required operating steps for the installation and operation of the device and the safety measures necessary for these purposes.

Furthermore, it contains technical data, application information and a basic description of the device and its specific components.

The operational and safety instructions given are to be followed in order to ensure the optimum operation of the device and to meet the warranty requirements of **TRONICO**.

## 1.2 Definition

**DCDC**: Direct Current to Direct Current converter.

**HV**: High Voltage

**LV**: Low Voltage

**CAN**: Controller Area Network

**EMC**: Electro-Magnetic Compatibility

**HVIL**: High Voltage Interlock Loop

## 1.3 Symbols

Throughout this manual, some specific symbols are used. You will find an overview of these symbols as well as their meanings:



Caution against serious personal injury or irreversible damage  
(ISO 7010 (W001))



Warning against HV risks  
(ISO 7010 (W012))



Warning against hot surface  
(ISO 7010 (W017))



Read the instructions before using  
(ISO 7010 (M002))



Earth ground  
(IEC 60417-5031 (2002-10))



Direct current  
(IEC 60417-3021 (2002-10))

## 2 GENERALLY APPLICABLE SAFETY MEASURES

The following safety measures have been developed based on the knowledge of TRONICO. They are not exhaustive; they can be supplemented by place and/or country-specific safety instructions and guidelines for accident prevention! These safety instructions from the system integrator and/or distributor must therefore be supplemented by specific country and local guidelines.

### 2.1 High Voltage

The DCDC converter works with High Voltage meaning **danger of death!** Never open the device. Opening the device voids any guarantee and warranty rights immediately.

**Lethal voltage** may be present in the device or on the connector just after power supply switch off. Always check the absence of voltage.

### 2.2 Installation safety

Installation must be done by **trained and qualified** persons who understand electrical hazards.

Always ensure that input and output power are **de-energized** before connecting or disconnecting cables.

Only use technically **suitable and high-quality** cables. Refer to chapter [5.3.2](#) for detailed instructions.

### 2.3 Safety instructions for cooling water systems

After running the cooling fluid may be hot. Be careful before unplugging the cooling system.

Refer to chapter [5.3.1](#) for detailed instructions.

### 2.4 Safety instructions for operation

- Never switch on a damaged device
- Do not place the device in direct sunlight and in direct proximity to heat sources
- Even though the device has Ingress Protection, direct contact with water (rain, splashing water) is to be avoided if possible
- Always check connections before switching on the device
- Only operate the device in its specified operational voltage range and power range
- Make sure your insulation protection is available: DCDC connected to the ground with safe installation or a permanent insulation controller

This User Manual must always be available to the operating personnel.

Refer to [Chapter 6 Operation](#): for detailed instructions.

#### **2.4.1** Personnel and organizational requirements

The DCDC converter works with High Voltage meaning **danger of death!**

All users working on or near the DCDC converter must have the required certificates according to the laws applicable in the country of use of the converter.

Installation and wiring methods shall be in accordance with the National Electrical Code, ANSI/NFPA 70 and with Canadian Electrical Code, part I.

#### **2.4.2** Transport

In case of return of the product, use the converter packaging used for the delivery of the DCDC converter.

If it is not possible, use an appropriate packaging for such a product and weight for flight and road transportation.

In case of damage on the product, **TRONICO** could charge you for the repairing of the product.

#### **2.4.3** Servicing information

No servicing is required on the DCDC converter.

#### **Advice:**

- Cooling system**  
Some liquids and materials (external of the

DCDC) can generate dust and waste into the cooling system. These elements can reduce its performances.

In order to insure to guaranty the compliancy of the cooling system with its requirements, it is recommended to check and wash it regularly depending on the conditions of use.

- Extreme environment**

In case of a use in an extreme environment (Humidity, Slat spray, corrosive liquids...) a frequently extern check can be operated to verify the screws and the housing.

## **2.5 Safety instructions during converter default**

If the DCDC meet a default to run:

- Switch off the power source on the low side.
- Switch off the power source on the High side.
- Switch off the auxiliary power supply.
- Switch off the liquid cooled system.
- The voltage can stay high for long time, avoid any handling during this time lapse.
- Disconnect the High and Low side connectors after checking if the voltage = 0V from High and Low side.
- Disconnect the auxiliary power supply connectors.
- Be careful before disconnecting the liquid cooled system pipes (IN and OUT), Risk of hot water splash

## **3 WARRANTY**

This product is warranted under the terms of our general conditions of sale and delivery if the conditions below are respected:

- Instructions of this manual have to be followed when using this product.
- No equipment modification or improper handling.
- Respect electrical safety conditions.

Be Careful, if the converter is used in a manner not specified, the protection provided by the equipment may be impaired.

In case of default on the product, please contact **Tame-Power** before any shipment. Bad declaration can have huge impacts on customs formalities and the treatment of the return.

The procedure is:

- Contact **Tame-Power**: alternative-energies@tronico-alcen.com
- Apply recommendation transmitted by **Tame-Power**.
- Prepare the shipment after confirmation by **Tame-Power**.
- Use the original packaging of the product.

## 4 PRODUCT INFORMATION AND LIMITATION

### 4.1 Proper use

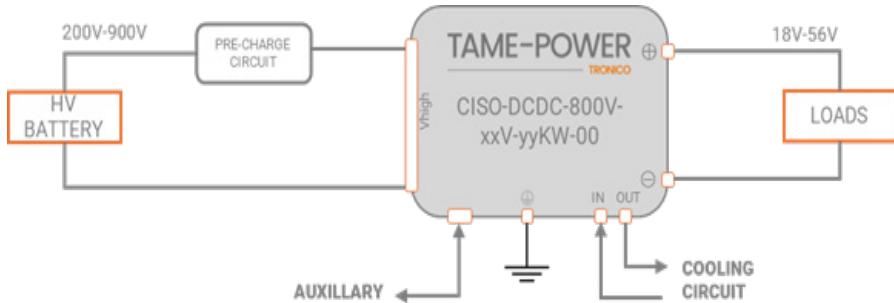
These Converters have been specially designed for the following applications:

- Battery systems
- Electric vehicles

This converter can be used in others DC applications. Ask **Tame-Power** support to optimize the use of the DCDC in your application. The converter can be used to transfer energy with different systems. It's used in Buck mode.

### 4.2 Field of applications

*Figure 1: Typical applications*



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## 4.3 Characteristics of your product

### 4.3.1 Converter's type plate

Figure 2: Identification plate

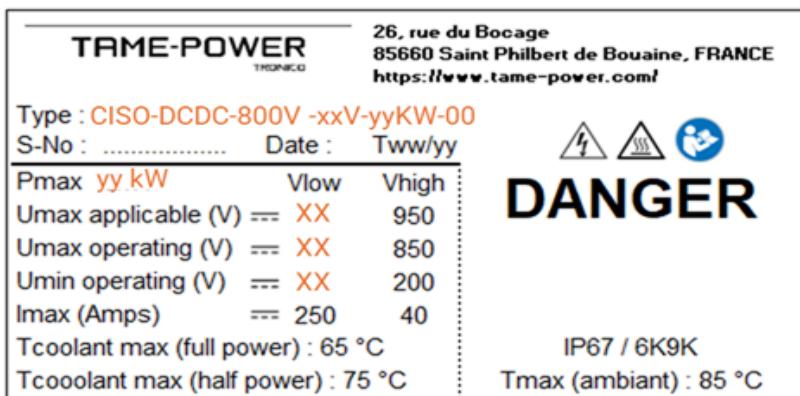


Table 1: Type plate signification

ITEM	SIGNIFICATION
Type	Converter Reference number See chapter « 4.3.2 » for more information.
S-No	Serial number
Date	Fabrication date (week number/year)
VLow	VLow side
VHigh	VHigh side
Tcoolant max (full power)*	Maximal coolant temperature for a use at full power
Tcoolant max (half power)*	Maximal coolant temperature for power transfer
Umax applicable	Maximal voltage applicable on Vlow or Vhigh without any damage to the DCDC
Umax operating	Maximum allowed voltage on Vlow or Vhigh to transfer power
Umin operating	Minimum allowed voltage on Vlow or Vhigh to transfer power
Imax	Limit of current on High side or Low side
Pmax**	Maximal output power of the converter
Configuration	Recommended power connection

\* Between Tcoolant max (full power) and Tcoolant max (half power) the product is limited (see figure 3)

\*\* See Specific datasheet of the product for the detail of power capability according to voltage configuration

#### 4.3.2 Reference signification

**CISO-DCDC-800V-xxV-yyKW-aa**

**Table 2: Letters signification**

CODE	INFORMATION	DESCRIPTIVE
xx	<i>Nominal output voltage</i>	24 = for 24V output voltage 48 = for 48V output voltage
yy	<i>Maximum power output</i>	6 = for 24V output voltage 12 = for 48V output voltage
aa	<i>Specific version</i>	00 = Basic version

Note :

- xxV: the 3 digits of maximal voltage specified the converter voltage in Volt on the High side.
- yyKW: the 3 digits of Maximum power output on the Low side.
- aa: these letters are for the specific version. Basically the number is 00.

#### 4.3.3 Main characteristics



Operation outside these limit values can lead to irreversible damage.

**Table 3: Main characteristics**

	CISO-DCDC-800V-24V-06KW	CISO-DCDC-800V-48V-12KW
Parameter	VALUE	
High side	200 V – 800 V	
Low side	18 V – 36 V	36 V -56 V
Maximum output current	250 A	
Power	6 KW	12 KW
AUXILIARY POWER VOLTAGE RANGE	6,5 V - 60 V	
Auxiliary power	12 W	
Storage temperature range	-40 °C TO +105 °C	
Operating ambient temperature	-40 °C TO +85 °C	
Pressure loss	100 mBar (@ 14 l/min, 25 °C)	
Inlet cooling temperature	-30 °C TO +65 °C	
Relative humidity	10 % TO 90 %	
Minimal rising time for voltage application on low and high side	500 µs	
Minimal output power	0W	

## 4.4 Technical data

### 4.4.1 Auxiliary supply

*Table 4: Auxiliary consumption*

VALUE	CISO-DCDC-800V- xxV-yyKW-00
Operation voltage	6,5 V – 60 V
Power max consumption	12 W
Current max consumption (operating at full power)	1,8 A

### 4.4.2 Control data

*Table 5: Auxiliary supply and control data*

CAN INTERFACE	
CAN version	2.0B (CAN FD compatible)
Default speed	1 Mbit/s
Frame Id (extend frame identifier)	29 bits
CAN periodicity	50 ms

The CAN speed can be changed, refer to chapter 10.3.3.

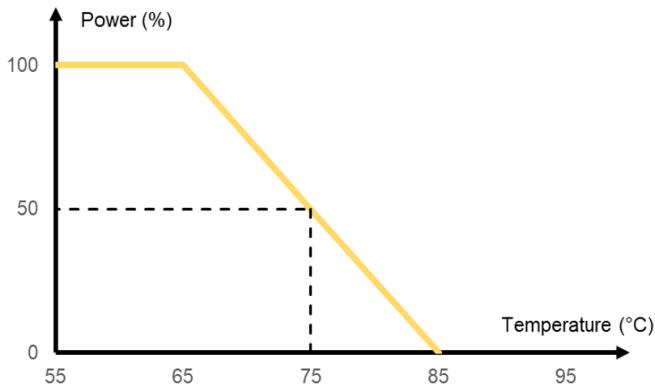
### 4.4.3 Cooling System

*Table 6: Cooling requirements*

	MIN	MAX	UNIT
Coolant Flow rate	3	15	L/MIN
Pressure drop (@14l/min, T=25°C)	-	100	mbar
Coolant Pressure	-	2	bar
Inlet liquid temperature	-30	+65	°C
Over temperature protection	65°C to 85°C		Derating
Fluid volume	≈300		cm <sup>3</sup>

Over temperature protection is enabled if the temperature is between 65°C to 80°C, the maximum power decreases to 0% with linear power (see figure 3 on next page). Be careful, the maximum Delta temperature from IN and OUT must not exceed 5°C.

**Figure 3: Derating power**



The liquid cooled converter is built with an internal flow network that assumes the cooling of the major internal heating components.

To calculate the cooling system, the following data shall be considered :

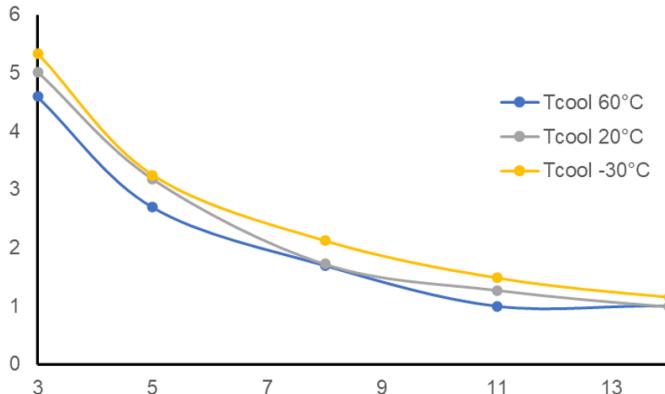
- The intlet temperature shall never exceed 65°C at full power.
- The power injection to the cooling circuit can be calculated with :

$$\text{Heat Power (W)} = \text{Max output(W)} \times [(1/\text{efficiency}) - 1]$$

The temperature elevation produced to the cooling liquid can be evaluated by the charts in the new page, according the 50% Water and 50% Glycol.

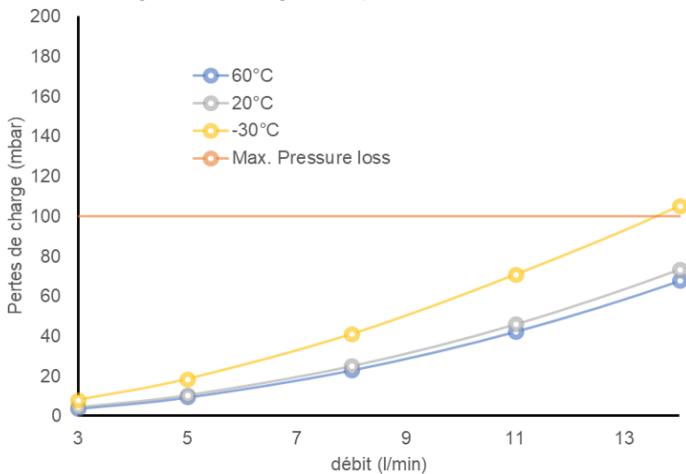
**The chart shows that with this power injected, the outlet liquid temperature will be about + 5.3°C @ 3l/min**

**Figure 4: Temperature elevation**



The pressure drop of the converter units are represented below (50% Water / 50% Glycol at -30°C, 20°C and 60°C).

**Figure 5: Cooling circuit pressure loss**



#### 4.4.4 Measurement accuracy

**Table 7: Measurement accuracy**

	TYP.	MAX	UNITS
Measured voltages accuracy	±0.5	±1	% of full scale
Measured low side current accuracy	±1.5	±3	% of full scale
Measured cooling temperature accuracy	±0.5	±1	°C

<sup>(1)</sup> For bi-directional converter, the current is always considered as positive.

#### 4.4.5 Basic Mechanical data

**Table 8: Mechanical data**

BASIC MECHANICAL DATA	SIMPLE SIZE
Weight	9 kg
Housing material	Aluminum
IP protection	IP6K9K <sup>(1)</sup>
Length	376mm
Width	306mm
Height	85mm

<sup>(1)</sup> IP6K9K is guaranty only when all connectors are plugged.

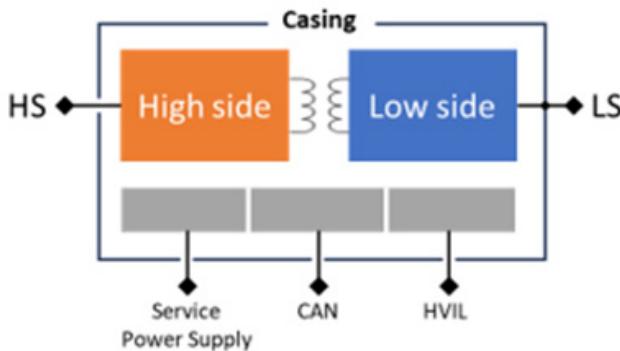
\*\* Dimension without connectors

Note : See the mechanical plan to chapter 5.4.1

#### 4.4.6 Insulation data

The insulation architecture is mapped according to the following figure.

**Figure 6: Insulation diagram**



**Tableau 9 : Insulation table**

Insulation chart						
	HS POWER	LS POWER	Auxiliary power supply	CAN	HVIL	CASING
<b>HS POWER</b>	-	B with insulation controller or gnd to be protected	B with insulation controller or gnd to be protected	A	A	B with insulation controller or gnd to be protected
<b>LS POWER</b>	-	-	GND commun	C	C	GND commun
<b>Auxiliary power supply</b>	-	-	-	C	C	C
<b>CAN</b>	-	-	-	-	C	C
<b>HVIL</b>	-	-	-	-	-	C
<b>CASING</b>	-	-	-	-	-	-

**Tableau 10 : Class description**

Class	Insulation voltage level	Description
A	4700 V	Reinforced insulation
B	3000 V	Main insulation
C	500 V	Functional insulation
G	0 V	Common ground

#### 4.4.7 EMC

The converter includes input and output filters designed to meet various standards for automotive applications. These filters can be tailored to suit your specific requirements.

According to your application and the other components in the system, we could have to add an EMC filter on Low side and/or High side.

For more details, please get in touch with [Tame-Power](#).

# 5 GLOBAL DESCRIPTION AND CONNECTION

## 5.1 Pre-charge system

As described above, the converter can be connected to any DC power sources and loads in accordance with the following criteria:

- Maximum voltage (continuous or spike) in accordance with the converter specification
- Maximum current consumption (continuous or spike) in accordance with the converter specification
- Use a pre-charge on Low side and High side in case of connection between a source and the converter through a circuit breaker.

Pre-charge recommendation:

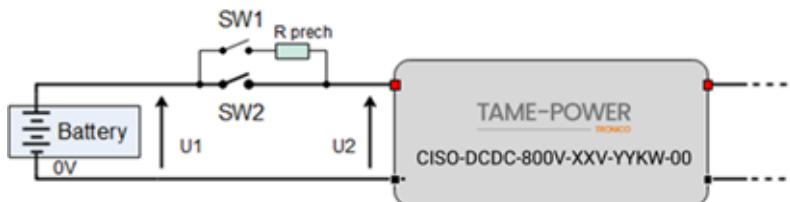
- Maximum pre-charge current is 5A
- Connection to the power source must be performed after verification of the voltage applied on the converter.
- The voltage drop between the Converter and the power source must be less than 30V

This is a typical pre-charge circuit and the associated sequence

This pre-charge is applicable on High side and Low side. Start the High side before the Low side due by the diode.

Tame Power product contains internal resistors on Low side and High side. The values depend on the configuration of the converter.

Figure 7: Pre-charge schematic



The sequence is:

- Close SW1 to pre-charge
- Check The voltage at the input of the DCDC ( $U_1 - U_2 < 30V$ )
- Close SW2 (if  $U_1 - U_2 < 30V$ )
- Open SW1 (Optional)

To avoid huge damage on the system and the converter, high-speed fuse is recommended on the low side and the High side. The fuse values are the responsibility of the user in accordance with the system and the converter capabilities.

## 5.2 Equipment installation and use

Please refer to the following chapters to correctly install and use the converter.

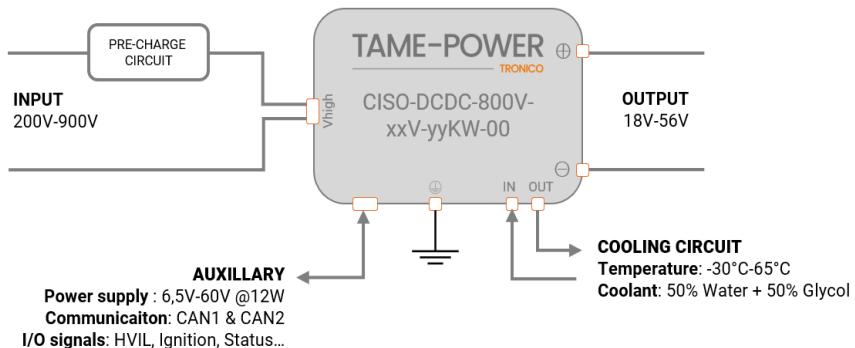
For the installation in your system :

- Only use matched connectors for connection
- Use cables with correct sizes
- Verify a correct installation and maintain the DCDC by using the appropriated holes or another suitable system.
- Connect the cooling system and verify that there is no trouble
- Check CAN configuration of your system and use terminal resistor if necessary ( $120\Omega$  1/4W)
- Connect the Ground connection or use an insulation controller
- Use Fuses according to the system and the converter capabilities

Before each use you must :

- Check that auxiliary voltage is in the available range
- Verify that high voltages cannot be above allowed values
- Use a pre-charge as defined below before connecting High voltages
- Check cooling system and the flow rate

Figure 8: Converter schematic with cables



Note : The number before each connector refer to the picture bellow. See chapter 5.4 Converter's connectors.

Before your installation, verify these different basic parameters to validate the good values with your system. For more information about the all parameters, refer to chapter 10.2 for more information.

Note : The CAN address configuration is 0x00.

Table 11: Basic parameters

PARAMETER NAME	IDENTIFIER	UNIT
Vhigh Max	0x3A	mV
Vhigh Min	0x3B	mV
Vlow Max	0x33	mV
Vlow Min	0x34	mV
CAN Address*	0x64	-
CAN Timeout*	0x65	0,1s
CAN Bitrate*	0x66	-

\* Parameter setup takes effect after reboot.

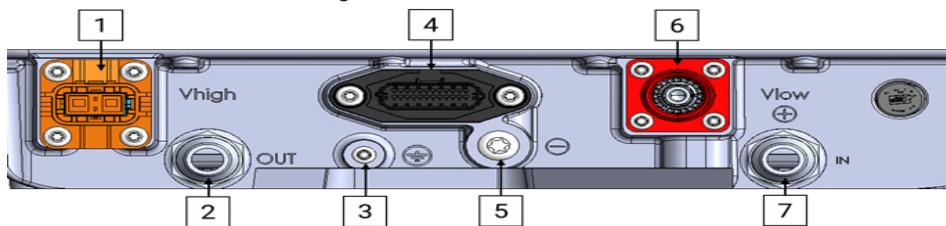
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## 5.3 Converter's connectors

The figure below shows the front of the DCDC converter, which contains all connectors.

**Figure 9: Converter connectors**



**Table 12: Connector's description**

PART NUMBER	DESCRIPTION	CHAPTER	MATCH WITH	
			Straight	Right angle
1	High voltage connector	5.3.4	X	X
2&7	Cooling system connector	5.3.1	X	
3	Grounding Connector	5.3.5	X	X
4	Signal connector	5.3.6	X	
5	Negative Low side connector	5.3.2	X	X
6	Positive Low side connector	5.3.2	X	X

### 5.3.1 Cooling system connection (2 & 7)

The cooling system connections are marked as «IN» for cooling liquid input and «OUT» for cooling liquid output on the converter's front panel.

The mating connector for the cooling system is NORMAQUICK PS3 NW12.

Ensure that the cooling water hoses are properly mounted on the connection pieces in order to avoid leaks. Fitting is realized with hose clamps.

- Please respect the liquid flow direction, input by connector 2 and output by connector 7.

### 5.3.2 Positive Low side connector (6)

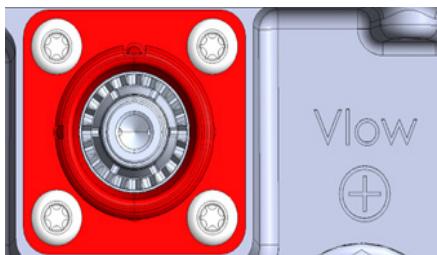
The building of the power wiring must be carried out in accordance with the connectors' manufacturer.

### 5.3.3 Negative Low side power connector (5)

The positive low side power connector is marked as «(+») on the converter's front panel.

The mating connector is SLPPC50BSRX from AMPHENOL, the Surlok plus series.

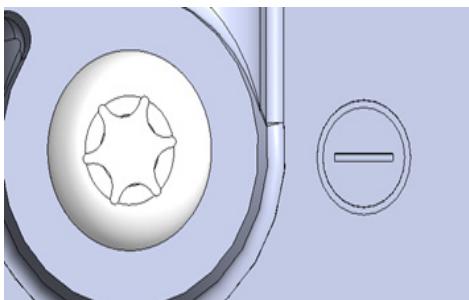
**Figure 10: Positive Low side connector**



The negative low side power connector is marked as «(-») on the converter's front panel.

Because the negative is linked to the ground, the negative low side connector is a simple M8 screw from the casing. It matches with M8 eyelet terminals.

**Figure 11: Negative Low side connector**



To avoid the formation of sparks as well as damage to the device, ensure that the cable is de-energized when connecting or disconnecting from the Converter.

Use a shielded cable with a maximum length of 3 meters.

### 5.3.4 High side power connector (1)

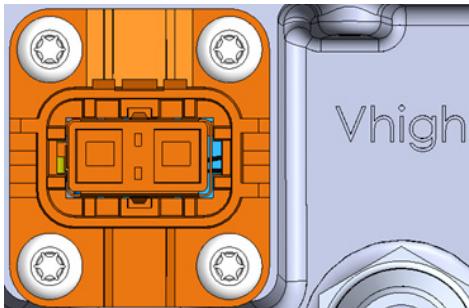
The High side power connector is marked as «(+») on the converter's front panel.

The mating connector is 13861584 from APTIV, the Shield-Pack HV 280 series.

The High side power connector includes a High Voltage Interlock Loop (HVIL) interface that is routed through the signal connector (4).

The converter does not read the HVIL state; therefore, it cannot be requested via CAN communication.

**Figure 12: High side connector**



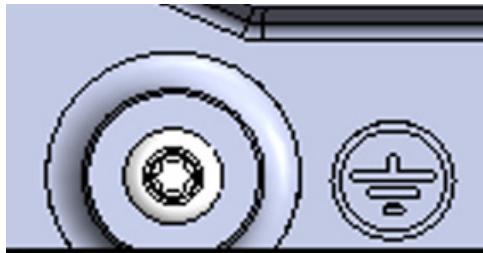
To avoid the formation of sparks as well as damage to the device, ensure that the cable is de-energized when connecting or disconnecting from the Converter.

The cable in use should be shielded and have a maximum length of 3 meters.

### 5.3.5 Grounding connector (3)

The converter has one screw with hexagonal nut (M8 Alu DIN934) for grounding connection.  
Torque should be set to 10Nm.

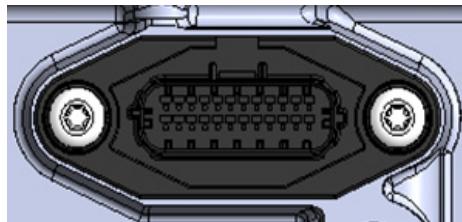
**Figure 13: Grounding connector**



### 5.3.6 Signal connector (4)

The mating connector is ZE064W-24DS-HU/R(A) from Hirose Electric reference Co. It is a small and waterproof connector for automotive interface, 24 positions, A Key.

**Figure 14: Signal connector**



**Table 13: Pinout of signal connector**

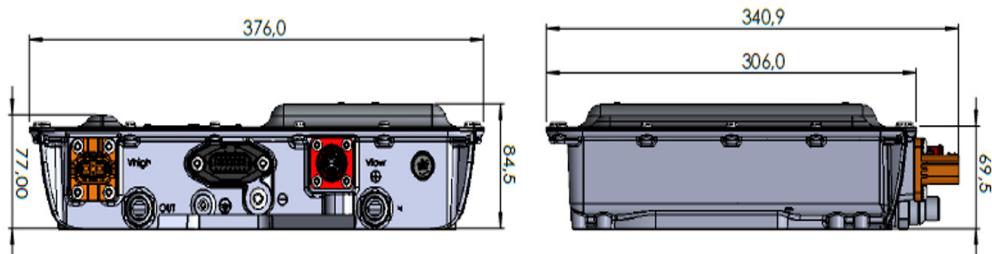
Refer to the table for connector pinout.

Pin #	Signal	Type	Comments
1	CAN1_H	I/O	
2	CAN1_Res1	I/O	Connected to CAN1_Res2 to activate the termination resistor
3	CAN2_H	I/O	
4	CAN2_Res1	I/O	Connected to CAN2_Res2 to activate the termination resistor
5	HVIL_1	O	Connected to HV connector (1)
6	+12V	PWR	
7	IGNITION	I	
8	STATUS	O	
9	Reserved		Reserved pin
10	Reserved		Reserved pin
11	SYNC_IN_P	I	
12	SYNC_OUT_P	O	
13	CAN1_L	I/O	
14	CAN1_Res2	I/O	Connected to CAN1_Res1 to activate the termination resistor
15	CAN2_L	I/O	
16	CAN2_Res2	I/O	Connected to CAN2_Res1 to activate the termination resistor
17	HVIL_2	O	Connected to HV connector (1)
18	Reserved		Reserved pin
19	GND	PWR	
20	WAKE-UP	I	
21	Reserved		Reserved pin
22	Reserved		Reserved pin
23	SYNC_IN_N	I	
24	SYNC_OUT_N	O	

## 5.4 Dimensions and installation information

### 5.4.1 Dimensions

Figure 15: Outside dimensions



### 5.4.2 Installation

Generally, no special installation position for the device is prescribed as the internal components are mounted in a vibration-resistant manner. However, the following installation positions are not advisable:

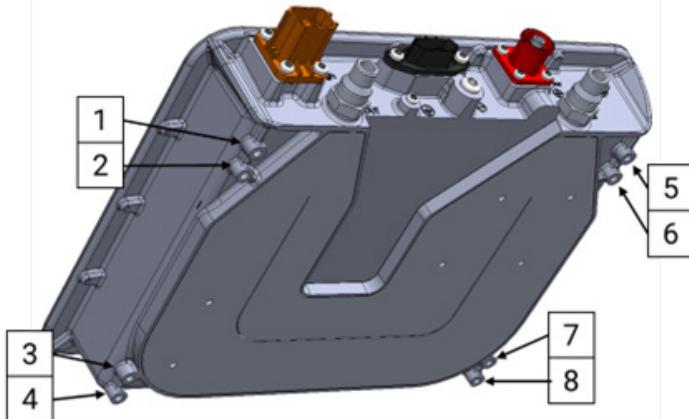
- Connector side to the top : This causes the danger of a condensate accumulation on the connectors, which increases the risk of corrosion.
- Connector side to the bottom: The water cooling circuit of the device has a U shape, which would now be upside down. In such case, the cooling circulation circuit is difficult, and the device may be cooled insufficiently.

For the installation of the device, the following points must be generally adhered to :

- Despite the existing IP protection, the device should only be exposed to environmental and influences to require by the application.
- The device may not be installed in the direct vicinity of heat sources (e.g. combustion engine).
- The mechanical fastening is to be aligned in such a way that the device is installed in a secured position and with as few vibrations as possible.

Each product features eight attachment points located on its underside (numbered 1 to 8). Utilize these attachment points to secure the product to your system.  
Use a 4mm diameter bolt with 4,8 Nm of torque.

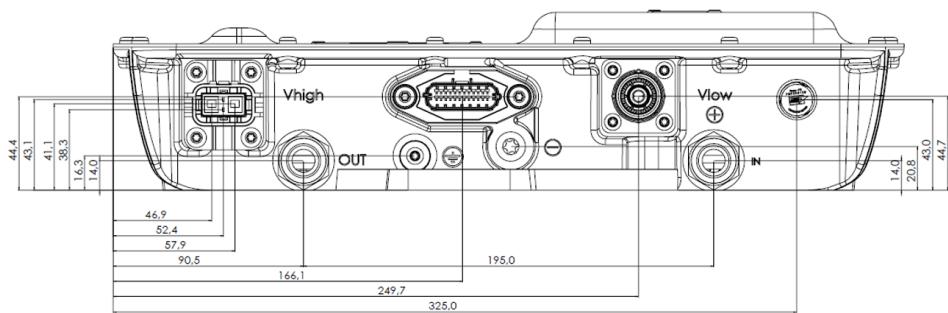
**Figure16 : Position of the fixing holes**



Note: The CAD (.step) file are available on [www.Tame-Power.com](http://www.Tame-Power.com).

#### 5.4.3 Connector positions

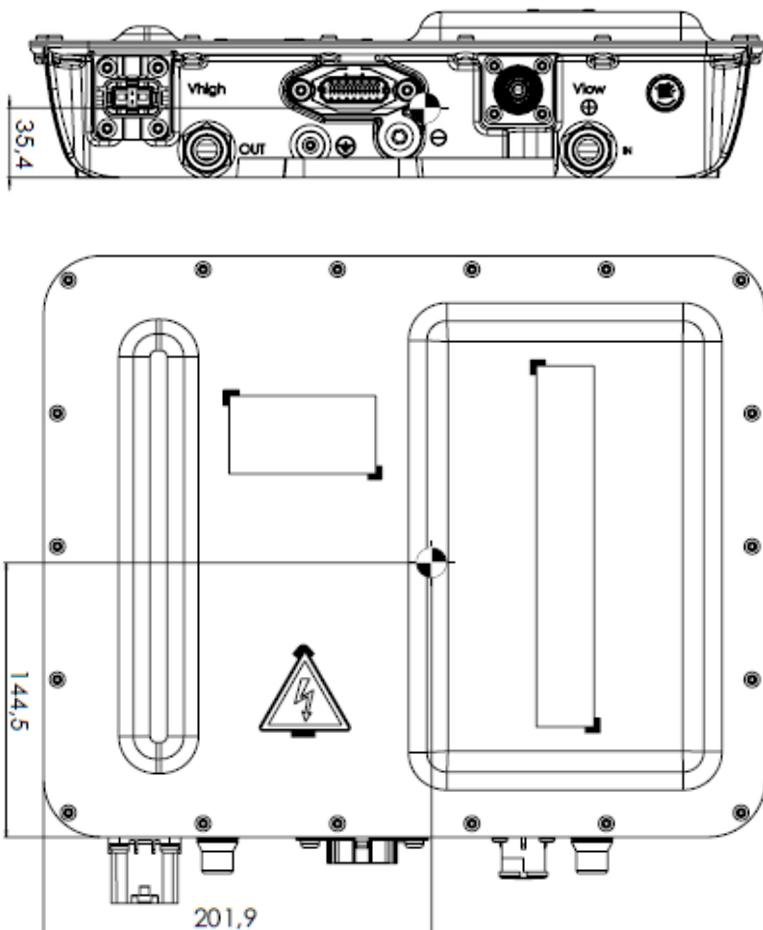
**Figure 17: Connector positions**



#### 5.4.4 Gravity center

The figure below shows the gravity center position of the converter.

Figure 18 : Gravity center position



# 6 OPERATION

## 6.1 Powering the DCDC Converter



When establishing the high side and low side connection always user the polarity.



When powering the DCDC converter be sure not to go higher than the maximum allowed voltage.

Always try to limit the voltage or current rising when powering the converter. A too fast powering can generate internal over voltage and damage the converter. Always use a pre-charging system, this will be detailed in section 5.1.

## 6.2 Powering sequence

To limit the risk of damage the powering must follow this sequence:

Power ON sequence:

- Start the auxiliary power supply
- Start the High side voltage
- Start the Low side voltage

Power OFF sequence:

- Stop the Low side voltage
- Stop the High side voltage
- Stop the auxiliary power supply

Don't switch-off the auxiliary power supply during power transfer (Running mode). It has the potential to cause irreversible damage to the converter.

## 6.3 High-voltage discharge circuit



The converter is equipped with a passive discharge circuit for discharging capacitor on DC bus (high side and low side) once they are disconnected from the converter.  
The voltage can stay high one minute, avoid any handling during this time lapse.

# 7 CONVERTER MODE AND CONTROL

## 7.1 Converter mode

The DCDC converter is designed to convert an input higher voltage to an output lower voltage.

Figure 19: Buck Converter



In Buck modes, the converter can operate as a current source or a voltage source. The control mode can be set as any of the following modes:

- Low side voltage VLow with current limitation
- Low side current ILow

## 7.2 CONTROL TYPE

### 7.2.1 Voltage control (in V)

The converter generates a voltage output from a power source supply on the High side. The picture below describes the converter in Buck mode with V low control type.

Figure 20 : V Low control type



### 7.2.2 Current control (in A)

The converter generates a current output from a power source supply on the High side. The picture below describes the converter in Buck mode with I low control type.

Figure 21 : I Low control type



### 7.2.3 Voltage control and current limitation (in V I Lim)

The converter generates a voltage with current limitation from a power source supply in High side. The picture below describes the converter in Buck mode with V Low I Lim control type.

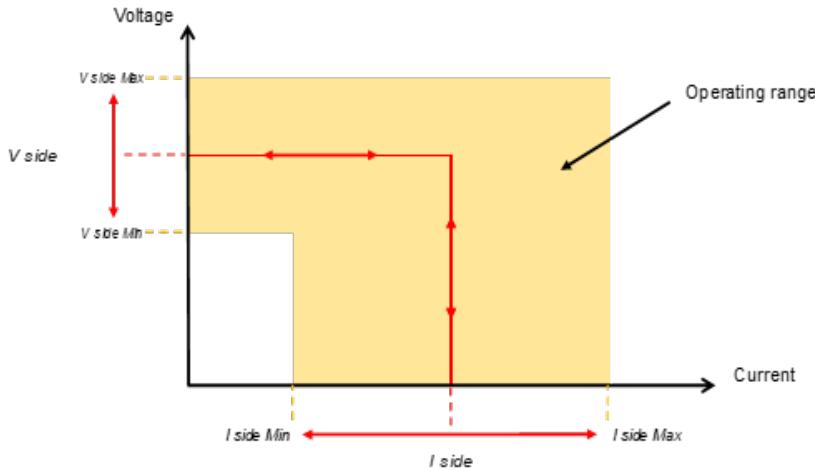
This mode does not work without voltage load (only use with Battery)

Figure 22 : V Low I Lim control type



Find below the operating range to use the converter with Voltage and Current limitation.

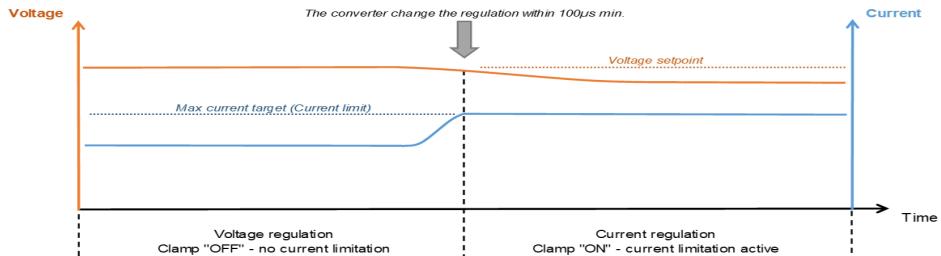
*Figure 23: Operating range graph*



#### 7.2.3.1 Current limitation

The current limitation runs with V I limitation control type only. When the output is on the voltage setpoint with the voltage load is below, the converter regulation runs on the current regulation. At the same time, the converter is "Clamp ON" (current regulation).

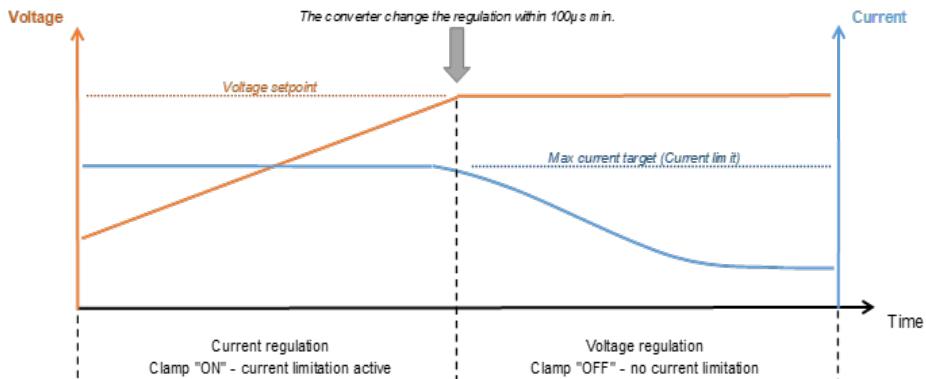
**Figure 24 : Current limitation**



### 7.2.3.2 Voltage regulation

The current limitation runs with V I limitation control type only. When the output is on the voltage setpoint with the voltage load is above, the converter regulation runs on the voltage regulation. At the same time, the converter is “Clamp OFF” (voltage regulation).

**Figure 25 : Voltage regulation**



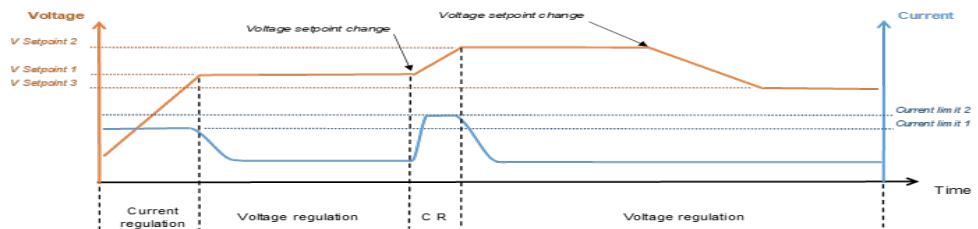
### 7.2.3.3 Example of Voltage I limitation

This typical use case works with different setpoint changes to charge the battery pack for example. The current limitation change follows the voltage regulation or current limitation.

**Table 14: Example of Voltage I limitation**

Control mode	Control type	Voltage setpoint 1	Voltage setpoint 2	Voltage setpoint 3	Current limit 1	Current limit 2
Buck	V Low I Lim	24 V	28 V	20V	100 A	150 A

**Figure 26 : Example of Voltage I limitation**



To use the V I Lim mode, choose the voltage setpoint and the current limitation in the control frame (0x00100000). For more details, refer to the control frame chapter.

# 8 DCDC PILOTING

## 8.1 Operating modes

The converter has the following operating modes:

- **Standby**: the converter is stopped.
- **Running**: the converter is running (it is transferring power).
- **Emergency**: there is at least one error. The power is stopped.

The converter goes to emergency when the previous state was standby only if a critical error occurs.

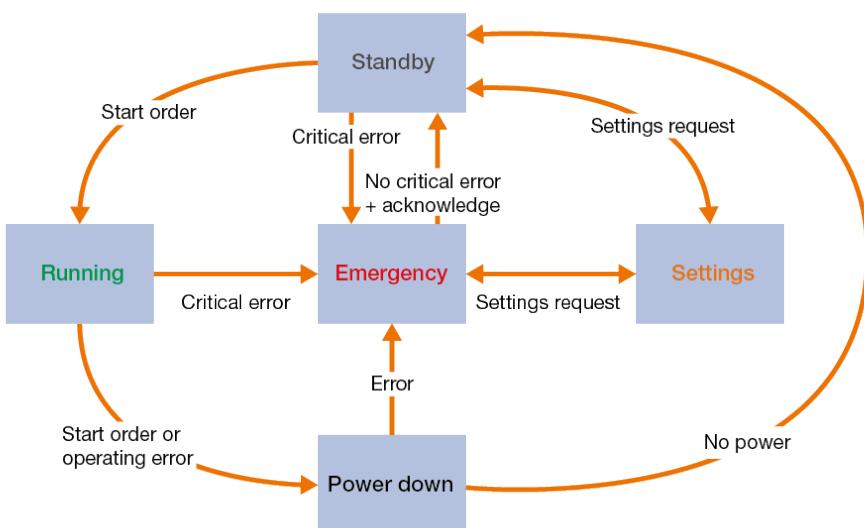
All critical errors shall be fixed before going back to standby state.

If there is an operating error and if a start order is given, the converter will enter the emergency state. These errors are read when the start order is requested.

When the converter is in Emergency state, errors shall be acknowledged before going back to standby state.

- **Power down**: this state is a transition state between the running state and the standby state. The converter enters the power down state after a stop order is given, and enters the standby mode after the stop time (defined by a parameter) and when the converter does not measure any power. This state is available when the converter is passed on emergency mode from the running mode due the operating errors.
- **Settings**: this state allows parameters modifications.

Figure 27 : Converter operating modes



## 8.2 CAN Communication

### 8.2.1 Requirements

The converter conforms to the CAN 2.0B standard. Frame identifiers are coded on 29 bits.

The following bit rates are supported:

CAN 2.0B:

- 500 kbps
- 250 kbps
- 125 kbps
- 1 Mbps, data bitrate = 1Mbps,

CAN FD

- 500kpbs, data bitrate = 2Mbps,
- 500kpbs, data bitrate = 5Mbps,
- 1Mbps, data bitrate = 5Mbps,
- 1Mbps, data bitrate = 8Mbps.

The endianness of the transmitted values is defined as "Little Endian" / Intel (LSBytes are sent first). Refer to section 9.1 for an example.

### 8.2.2 Frame description

The CAN identifier of a message is composed of a message identifier and of the address of the converter.

**Table 15: Frame description**

BIT 29	BIT 28	BIT 8	BIT 7	BIT 0
Unused	Message identifier	Converter address		

Example: if the address of a converter is 0xAB (Refer to section 10 to change the address):

- The frame ID of the measures 1 frame sent by the converter is 0x033000AB
- The frame ID of the control frame sent to the converter shall be 0x001000AB

## 8.3 Errors and warnings

### 8.3.1 Overview

Three kinds of status can be generated by the converter:

- Critical errors
- Operating errors
- Warnings

When a critical error occurs, the converter transitions into the emergency state, and power conversion is halted immediately. Acknowledging all critical errors is necessary to return the converter from the emergency state.

If the converter is in operational mode and encounters an operational error, it transitions into the power-down state. Power is then cut off in accordance with the stop time parameter upon receiving a stop order. Immediately, the converter enters the emergency state until the errors are acknowledged.

The error and warning frames are detailed in chapter 9.5.7 and chapter 9.5.8

### 8.3.2 Critical errors

**Table 16: Critical errors**

ERROR	CAUSE	SOLUTION
Auxiliary power supply minimum	Internal alimentation error	Check the auxiliary voltage and connection
Auxiliary power supply maximum		
V High maximum critical	The mentioned voltage as reach a too high level	Can be due to an unconnected load
V Low maximum critical		
I Low maximum critical	The mentioned current as reach a too high level	Probably due to a short circuit on the load
I High maximum critical		
Internal error	An internal error occurred	If the problem persists after rebooting the converter, please contact <a href="#">TRONICO</a>
Hardware PWM trip zone	A V High Max Critical, V Low Max Critical error or Auxiliary power supply shutting down occurred	-
Power down timed out	The converter still measures power after power cut off ( $T > 200$ ms + stop time)	-
Power up timed out	The converter does not measure power after starting up	-
Emergency power down timed out	The converter still measures power after an operating error ( $T > 500$ ms)	-
Unknown control mode	Requested control mode is unknown	Received control mode is unknown. Control system shall send a valid control type request
Unknown control type	Requested control type is unknown	Received control type is unknown. Control system shall send a valid control type request
Parameter	Internal parameters are false or disable	If the problem persists after rebooting the converter, please contact <a href="#">TRONICO</a>
UV9V	Auxiliary power supply is < 9V	Check the auxiliary voltage and connection
UV6,5V	Auxiliary power supply is < 6,5V	
UV12V HT	Auxiliary power supply is too low	
Power map	Internal parameters are false or disable	If the problem persists after rebooting the converter, please contact <a href="#">TRONICO</a>

### 8.3.3 Operating errors

**Table 17: Operating errors**

ERROR	CAUSE	SOLUTION
V High minimum	V High < VHighMin during 1s	Check operating conditions or change VHighMin parameter value
V High maximum	V High > VHighMax during 1s	Check operating conditions or change VHighMax parameter value
V Low minimum	V Low < VLowMin during 1s	Check operating conditions or change VLowMin parameter value
V Low maximum	V Low > VLowMax during 1s	Change operating conditions or change VLowMax parameter value
I High maximum	I High < IHIGHMax during 1s	Check operating conditions or change IHIGHMax parameter value
I Low maximum	I Low > ILowMax during 1s	Check operating conditions or change ILowMax parameter value
Output coolant temperature critical minimum	Output T° < -40°C during 1s	Check the coolant temperature and the flow rate
Output coolant temperature critical maximum	Output T° > 80°C during 1s	
Input coolant temperature critical minimum	Input T° < -40°C during 1s	
Input coolant temperature critical maximum	Input T° > 80°C during 1s	
Communication loss	Communication was lost during T > CAN Timeout	Check control system sending period or change CAN Timeout parameter value
Communication mode not set	Control mode is not set	Control system shall send the request control mode
Power limit reached	Power limit reached in voltage control type: during 1s	-
Illegal mode change request	A start order was given while it is not possible to start up	-

### 8.4.4 Warnings

Warnings are sent for information purpose only and cannot be acknowledged.

**Table 18: Warnings list**

WARNING	CAUSE
High input coolant temperature	Input coolant temperature > 65°C during 1s
High output coolant temperature	Output coolant temperature > 70°C during 1s
Setpoint unreachable too low	setpoint is too low and cannot be reached during 1s
Setpoint unreachable too high	Setpoint is too high and cannot be reached (or the power limit is reached) during 1s
Auxiliary power supply shutting down	Converter power supply is not correct. Converter is shutting down
High temperature delta	The coolant temperature difference is greater than 5°C

# 9 CAN PROTOCOL

## 9.1 Overview

A CAN frame is composed of the following fields:

**Table 19: CAN frame**

SOF	ARBITRATION FIELD	CONTROL FIELD	DATA FIELD	CRC FIELD	ACK	EOF
1 bit	30 bits	6 bits	0-64 bits	16 bits	2 bits	7 bits

The frame is transmitted from the SOF (Start Of Frame) to the EOF (End Of Frame), in this order. For each field, the most significant bit is sent first.

When numbers larger than one byte are sent, the “Little Endian” convention is used. Here is an example of a “measures2” frame, containing two data fields (P Low from bytes 0 to 3 and P High from bytes 4 to 7):

**Table 20 : Example of a Measures 2 frame on the CAN bus**

	BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE 4	BYTE 5	BYTE 6	BYTE 7	
Control	0x29	0x09	0x00	0x00	0x07	0x02	0x00	0x00	CRC

The power measures received shall be read as follows :

- P Low = 0x00000929 = 2345 W
- P High = 0x00000207 = 519 W

## 9.2 Data Types

The following data types are used in this protocol and refer to a specific way of coding numbers:

- **Unsigned: unsigned number.**
- **Signed:** two's complement signed number (the size of the number is either 16 or 32 bits).

## 9.3 Frame List

### 9.3.1 From DCDC converter to control system

The different frames the DCDC converter can send are described below.

**Table 21: Frame list from the DCDC**

FRAME TYPE	FRAME NAME	SENDING PERIOD	FRAME SIZE (BYTES)	MESSAGES IDENTIFIER
Data	Measures 1 (Current measures)	20 ms	4	0x03300000
Data	Measures 2 (Power measures)	20 ms	8	0x03D00000
Data	Measures 3 (Temperature measures)	20 ms	8	0x04700000
Data	Measures 4 (Voltage measures)	20 ms	4	0x04800000
Status	Regulation information	20 ms	6	0x06F00000
Status	Control information	20 ms	4	0x07900000
Status	Errors	20 ms	8	0x01F00000
Status	Warnings	20 ms	4	0x05500000
Data	Parameter value	-	7	0x08D00000

### 9.3.2 From control system to DCDC converter

**Table 22: Frame list to the DCDC**

FRAME TYPE	FRAME NAME	SENDING PERIOD	FRAME SIZE (BYTES)	MESSAGE IDENTIFIER
Request	Control	20 ms	7	0x00100000
Request	Mode request	-	2	0x00500000
Request	Information request	-	1	0x02900000
Request	Parameter request	-	7	0x08300000
Request	Error rest	-	0	0x05B00000
Request	Settings mode	-	1	0x09700000

## 9.4 Frames and timing

The converter treats the received frames every 20ms. Within a given ID, if frames are received more than every 20ms, only the last received frame is treated.

By default, the converter periodically sends information about its state, every 20ms. It is possible to configure the period or disable the periodic transmission of these messages thanks to some parameters. User can send «Information request» frame to get the information needed whatever he wants.

The control frame shall be sent periodically to the converter otherwise the converter will enter in emergency mode. The maximum sending period is defined by the CAN Timeout parameter (by default: 1 s).

*Note : The DBC file is available to have more frame details, please contact Tame-Power.*

## 9.5 Frame Details

### 9.5.1 Current measures

- From Converter (Read)  
Frame Identifier: **0x03300000**  
Period of emission: 20ms  
DLC: 4

Payload:

0	15	16	31	
IBus1		IBus2		
BITS	FIELD	UNIT	OFFSET	DESCRIPTION
0-15	IBus1	0,1 A	-3276.8	Bus1 current value
16-31	IBus2	0,1 A	-3276.8	Bus2 current value

Example:

CAN ID	LENGTH	DATA
03300000	4	F3 7F 53 81

3E 01 24 02	IBus1 = F3 7F	0x07FF3 = 33775*0,1A - 3276.8 = -1.3A
	IBus2 = 53 81	0x8153 = 33107*0,1A - 3276.8 = 33.9A

### 9.5.2 Power measures

- From Converter (Read)
- Frame Identifier: **0x03D00000**  
 Period of emission: 20ms  
 DLC: 8  
 Payload:

0	31 32	63		
P Bus2		P Bus1		
BITS	FIELD	UNIT	OFFSET	DESCRIPTION
0-31	P Bus2	W	0	Bus2 power value
32-63	P Bus1	W	0	Bus1 power value

Example:

CAN ID	LENGTH	DATA
03D00000	8	B6 57 00 00 05 57 00 00

B6 57 00 00	P Low = B6 57 00 00	0x000057B6 = 22454*1W = 22454W
05 57 00 00	P High = 05 57 00 00	0x00005705 = 22277*1W = 22277W

### 9.5.3 Temperature measures

- From converter (Read)
- Frame Identifier: **0x04700000**  
 Period of emission: 20ms  
 DLC: 8  
 Payload:

0	7 8	15 16	23 24	31 32	39 40	47 48	55 56	
63	Temp 1	Temp 2	Temp 3	Temp 4	Temp 5	Temp 6	Temp 7	Temp 8

BITS	FIELD	UNIT	OFFSET	DESCRIPTION
0-7	Temp 1	°C	-50	Temperature 1
8-15	Temp 2	°C	-50	Temperature 2
16-23	Temp 3	°C	-50	Temperature 3
24-31	Temp 4	°C	-50	Temperature 4
32-39	Temp 5	°C	-50	Temperature 5
40-47	Temp 6	°C	-50	Temperature 6
48-55	Temp 7	°C	-50	Temperature 7
56-63	Temp 8	°C	-50	Temperature 8

Example:

CAN ID	LENGTH	DATA
04700000	8	02 F1 25 15 00 FF 92
02	Temp 1 = 02	0x02 = -48°C
F1	Temp 2 = F1	0xF1 = 191°C
25	Temp 3 = 25	0x25 = -13°C
15	Temp 4 = 15	0x15 = -29°C
00	Temp 5 = 00	0x00 = -50°C
FF	Temp 6 = FF	0xFF = 205°C
92	Temp 7 = 92	0x92 = 96°C

#### 9.5.4 Voltages measures

- From converter (Read)
   
Frame Identifier: **0x04800000**
  
Period of emission: 20ms
   
DLC: 4

Payload:

0	15	16	31	
V Bus1		V Bus2		
BITS	FIELD	UNIT	OFFSET	DESCRIPTION
0-15	V Bus1	0,1 V	0	Bus1 voltage value
16-31	V Bus2	0,1 V	0	Bus2 voltage value

Example:

CAN ID	LENGTH	DATA
04800000	4	59 1B F7 0F
59 1B F7 0F	V High = 59 1B	0x1B59 = 7001*0,1V = 700,1 V
	V Low = F7 0F	0x0FF7 = 4087*0,1V = 408,7 V

### 9.5.5 Set-point information

- From converter (Read)
- Frame Identifier: **0x06F00000**  
 Period of emission: 20ms  
 DLC: 6

Payload:

0	7	8	39	40
47				

Operating mode		Set point	Limitation Type	
Bits	Field	Unit	Offset	Description
0-7	Software mode	-	-	0x00: Emergency 0x01: Standby 0x02: Running 0x03: Power down 0x04: Settings other values: unused
8-39	Set point	See description	0	The set point received by the converter is sent back. The unit of the set point depends on the current control type of the converter. Voltage and current set points are expressed in 0.1 A and 0.1 V, power set points are expressed in W.
40-47	Limitation type	-	-	bit 40: Temperature limitation (0: inactive, 1: active) bit 41: Ramp limitation (0: inactive, 1: active) bit 42: Power limitation (0: inactive, 1: active) other bits: unused

Note:

**Temperature limitation** is active when the temperature warning is set.

**Ramp limitation** is active on start-up and stop sequences, and on a setpoint change accordingly to the associated parameters.

**Power limitation** is active following the derating. See chapter [4.5.3](#) for more details.

It is possible to have a temperature limitation and power limitation in the same time for example.

Examples :

- Control Type is P High:  
(The setpoint information depends on control type frame)

CAN ID	LENGTH	DATA
06F00000	6	02 A8 61 00 00 04

02 A8 61 00 00 04	Operating mode = 02	0x02 = Running mode
	P High = A8 61 00 00	0x61A8 = 25000*1W = 25000W
	Limitation Type = 04	0x04 = Power limitation

- Control Type is V High:

CAN ID	LENGTH	DATA
06F00000	6	03 70 17 00 00 02

03 70 17 00 00 02	Operating mode = 03	0x03 = Power down mode
	V High = 70 17 00 00	0x1770 = 6000*0,1V = 600V
	Limitation Type = 02	0x02 = Ramp limitation

- Control Type is I Low:

CAN ID	LENGTH	DATA
06F00000	6	02 9C 04 00 00 02 0

02 9C 04 00 00 02 0	Operating mode = 02	0x02 = Running mode
	I Low = 9C 04 00 00	0x49C = 1180*0,1A = 118A
	Limitation Type = 02	0x02 = Ramp limitation

### 9.5.6 Control information

- From converter (Read)
- Frame Identifier: **0x07900000**  
 Period of emission: 20ms  
 DLC: 4

Payload:

0	7 8	15 16	1
3			

Converter mode		Control type		Max current target
BITS	FIELD	UNIT	TYPE	DESCRIPTION
0-7	Converter mode	-	-	0x01: Bus1 to Bus2 0x02: Bus2 to Bus1 0x03: Bidirectional other values: Converter mode not set
8-15	Control type	-	-	0x01: vBus2 0x02: vBus1 0x03: iBus1 0x04: iBus2 0x05: pBus2 0x06: pBus1 0x07: vBus2Lim 0x08: vBus1Lim other values: Converter type not set
16-31	Max current target	0,1 A	Unsigned	This option is only used when control type is: <ul style="list-style-type: none"> <li>- vBus2Lim (0x07)</li> <li>- vBus1Lim (0x08)</li> </ul> See mode request frame (0x00500000) chapter 9.5.11, to change the control type.

Example:

CAN ID	LENGTH	DATA
07900000	4	01 03 00 00

01 02 00 00	Converter mode = 01	0x01 = vBus2
	Control type = 03	0x02 = iBus1
	Max current target = 00 00	0x00 = 0A

### 9.5.7 Errors

- From converter (Read)
- Frame Identifier: **0x01F00000**  
 Period of emission: 20ms  
 DLC: 8  
 Payload:

0		31	32	63
Critical errors			Operating errors	

Payload details:

Errors 1: Critical errors

	0	1	2	3	4	5	6	7
BYTE 1	power map		iBus1Leg2 max critical	iBus2Leg1 max critical	iBus1Leg2 max critical	iBus1Leg1 max critical	vBus2 max critical	vBus1 max critical
	8	9	10	11	12	13	14	15
BYTE 2	Voltage Sensor inoperational	Current Sensor inoperational	Mosfet Driver fault	Power Supply FPGA Lost	Power Supply MCU Lost	FPGA clock Unsync	MCU clock	FPGA lost
	16	17	18	19	20	21	22	23
BYTE 3	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used
	24	25	26	27	28	29	30	31
BYTE 4	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used

## Errors 2 : Operating errors

	32	33	34	35	36	37	38	39
BYTE 5	Output coolant temperature critical amximum	Output coolant temperature critical minimum	iBus2Leg2 max	iBus2Leg1 max	vBus2 Max		vBus1 Max	vBus1 Min
BYTE 6	40	41	42	43	44	45	46	47
	Coolant delta temperature max critical	Self-temperature critical max temperature critical max	Transformer temperature critical max	Mosfet temperature critical max	Ambient critical max	Ambient critical min	Input coolant temperature critical max	Input coolant temperature critical min
BYTE 7	48	49	50	51	52	53	54	55
	Not used	Inoperational temperature sensor	Power limit reached	Control loop not set	Incompatible control mode type	Unknown control type	Unknown control mode	CAN com is lost
BYTE 8	56	57	58	59	60	61	62	63
	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used

- Example for critical errors :

CAN ID	LENGTH	DATA
01F000000	8	10 00 00 00 65 01 00 00

10 00 00 00	0x10 = BYTE 1	10 from hex to binary	10 = 0001 0000
	0x00 = BYTE 2		
	0x00 = BYTE 3		
	0x00 = BYTE 4		

Insert the binary code in the table on the following page.

Table details :

	0	1	2	3	4	5	6	7
BYTE 1	power map	parameters	iBus1Leg2 max critical	iBus2Leg1 max critical *	iBus1Leg2 max critical	iBus1Leg1 max critical	vBus2 max critical	vBus1 max critical
Binary result	0	0	0	1	0	0	0	0



Errors 1 = iBus2Leg1 max critical

- Example for operating errors:

CAN ID	LENGTH	DATA
01F000000	8	10 00 00 00 65 01 00 00

65 01 00 00	0x65 = BYTE 5	65 from hex to binary	65 = 0110 0101
	0x02 = BYTE 6	01 from hex to binary	01 = 0000 0001
	0x00 = BYTE 7		
	0x00 = BYTE 8		



Table details :

	32	33	34	35	36	37	38	39
BYTE 5	Output coolant temperature critical amximum	Output coolant temperature critical minimum		iBus2Leg1 max	vBus2 Max	vBus2 Min	vBus1 Max	vBus1 Min
Binary result	0	1	1	0	0	1	0	1

Errors 2 = Output coolant temperature critical min + iBus2Leg2 max + vBus2 Min + vBus1 Min + Input coolant temperature critical min

Table details:

BYTE 6	40	41	42	43	44	45	46	47
	Coolant delta temperature max critical	Self temperature critical max	Transformer temperature critical max	Mosfet temperature critical max	Ambient critical max	Ambient critical min	Input coolant temperature critical max	Input coolant temperature critical min
Binary result	0	0	0	0	0	0	0	1



Errors 2 = Input coolant temperature critical min

Errors results:

CAN ID	LENGTH	DATA
01F000000	8	10 00 00 00 65 01 00 00

Errors 1 = iBus2Leg1

Errors 2 = Output coolant temperature critical min + iBus2Leg2 max + vBus2 Min + vBus1 Min + Input coolant temperature critical min

### 9.5.8 Warnings

- From Converter (Read)  
Frame Identifier: **0x05500000**  
Period of emission: 20ms  
DLC: 4

Payload:

0

31

Warnings

Payload details on the following page.

Playload details:

	0	1	2	3	4	5	6	7
BYTE 1	Setpoint unreachable too low	High coolant delta temperature	High self temperature	High transformer temperature	High mosfet temperature	High ambient temperature	High input coolant temperature	High output coolant temperature
BYTE 2	8	9	10	11	12	13	14	15
	Not used	Not used	Not used	Not used	Backup	Backup application started	Control Type change Not allowed	Setpoint unreachable too high
BYTE 3	16	17	18	19	20	21	22	23
	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used
BYTE 4	24	25	26	27	28	29	30	31
	Not used	Not used	Not used	Not used	Not used	Not used	Not used	Not used

Example:

CAN ID	LENGTH	DATA
05500000	4	04 00 00 00
04 00 00 00	0x04 = BYTE 1	04 from hex to binary
	0x00 = BYTE 2	04 = 0000 0100
	0x00 = BYTE 3	
	0x00 = BYTE 4	

Insert the binary code in the table below.

Table details:

	0	1	2	3	4	5	6	7
	Setpoint unreachable too low	High coolant delta temperature	High temperature delta	High transformer temperature	High mosfet temperature	High ambient temperature *	High input coolant temperature	High output coolant temperature

Warnings = set point unreachable too low



Warning results:

CAN ID	LENGTH	DATA
05500000	4	04 00 00 00

Warnings = Set point unreachable too low

### 9.5.9 Parameters Value

Refer to section [10.2](#) for parameter examples.

For « Parameter Id » fields, refer to section [10.2](#) for details.

- From Converter (Read)  
Frame Identifier: **0x08D00000**  
Period: sent when « Parameter request » frame is received  
DLC: 7

Payload:

0	15	16	47	48	55
Parameter ID		Parameter Value			Status
BITS	FIELD	UNIT	TYPE	DESCRIPTION	
0-15	Parameter ID	-	Unsigned	Refer to section <a href="#">10.2</a>	
16-47	Parameter value	-	Signed	Refer to section <a href="#">10.2</a>	
48-55	Status	-	-	0x00: Failure 0x01: Success other values: unused	

Save Operation:

After a « Save » operation, the parameter value frame is sent with the following information:

- Parameter ID: 0xFFFF
- Status: success or failure

Possible reasons for a status field= Failure :

- Read or Update action of a parameter that does not exists, in this case, the parameters value field take the 0xFFFF value.
- On an Update action, if the new parameter value is not in the allowed range, the status field is equal to failure and the parameter value field takes the actual parameter value.
- On a Save action, the status field takes the failure value if an error occurred during the operation.
- The converter isn't in settings mode.

Examples :

- Read successful answer :

CAN ID	LENGTH	DATA
08D00000	7	31 00 00 C4 09 00 01
31 00 00 C4 09 00 01	Parameter ID = 3A 00	0x0031 = VBus1Max Parameter
	Parameter value = 00 C4 09 00	0x0009C400 = 640 000 mV (640V)
	Status = 01	0x01 = Request status is successful

- Write failure answer :

CAN ID	LENGTH	DATA
08D00000	7	FF FF 00 00 00 00 01
FF FF 00 00 00 00 01	Parameter ID = FF FF	0xFFFF = all parameters are save
	Not used in save mode	
	Status = 01	0x01 = Request status failed

- Save all parameters answer :

CAN ID	LENGTH	DATA
08D00000	7	FF FF 00 00 00 00 01
FF FF 00 00 00 00 01	Parameter ID = FF FF	0xFFFF = all parameters are save
	Not used in save mode	
	Status = 01	0x01 = Request status is successful

### 9.5.10 Control

Refer to section 9.6.2 and 9.6.3 for startup and stop example sequences.

- Send to converter (write)
- Frame Identifier: **0x00100000**  
 Period: shall be received every 20ms  
 DLC: 7

Payload:

0	7	8		39	40	55		
Start command		Set point			Max current target			
BITS	FIELD	UNIT	OFFSET	DESCRIPTION				
0-7	Start command	-	-	0x00: Stop order 0x01: Start order other values: unused				
8-39	Setpoint	see Description	0	The set point received by the converter is sent back. The unit of the set point depends on the current control type of the converter. Voltage and current set points are expressed in 0,1 A and 0,1 V, power set points are expressed in W.				
40-55	Max current target	0,1 A	0	<b>This option is only used when control type is:</b> <ul style="list-style-type: none"> <li>• V High I Lim (0x09)</li> <li>• V Low I Lim (0x0A)</li> </ul> <b>See mode request frame (0x00500000)</b>  To indicate the maximum current value allowed. This field is expressed in 0,1 A.				

Examples:

- V High Control type:

CAN ID	LENGTH	DATA
00100000	7	01 94 11 00 00 00 00
01 94 11 00 00 00 00	Start command = 01	0x01 = Start order
	V High Control Type = 94 11 00 00	0x01194 = 4500*0,1V = 450V
	Max current target = 00 00	0x0000 = 0*0,1A = 0A

- P High Control type:

CAN ID	LENGTH	DATA
00100000	7	00 94 11 00 00 00 00
00 94 11 00 00 00 00	Start command = 00	0x00 = Start order
	P High Control Type = 94 11 00 00	0x01194 = 4500*1W = 4500W
	Max current target = 00 00	0x0000 = 0*0,1A = 0A

- I Low Control type:

CAN ID	LENGTH	DATA
00100000	7	01 94 11 00 00 00 00
01 94 11 00 00 00 00	Start command = 01	0x01 = Start order
	I Low Control Type = 94 11 00 00	0x01194 = 4500*0,1A = 450A
	Max current target = 00 00	0x0000 = 0*0,1A = 0A

### 9.5.11 Mode request

- Send to converter (write)  
Frame Identifier: **0x00500000**  
Period: request  
DLC: 2

Payload:

0	7	8	15	
Converter Mode			Control Type	
BITS	FIELD	UNIT	TYPE	DESCRIPTION
0-7	Converter mode	-	-	0x01: Bus1 to Bus2 0x02: Bus2 to Bus1 other values: Converter mode not set
8-15	Control type	-	-	0x01: vBus2 0x02: vBus1 0x03: iBus1 0x04: iBus2 0x05: pBus2 0x06: pBus1 0x07: vBus2 Lim 0x08: vBus1 Lim other values: Converter type not set

Example:

CAN ID	LENGTH	DATA
00500000	2	02 05
02 05	Converter Mode= 02	0x02 = Bus2 to Bus1
	Control Type= 05	0x05 = I Low

### 9.5.12 Information Request

- Send to converter (write)  
Frame Identifier: **0x02900000**  
Period of reception: request  
DLC: 1

Payload:

0

7

Information Request				
BITS	FIELD	UNIT	TYPE	DESCRIPTION
0-7	Information request	-	-	0x01: Errors frame request 0x02: Warnings frame request 0x03: Current measures frame request 0x04: Power measures frame request 0x05: Voltage measures frame request 0x06: Temperature measures frame request 0x08: Regulation information request 0x09 : Control information request others: not used

Check the parameters table in chapter [10.2](#) before to see if the parameter = 0. If the parameter = 1, the converter send every 20ms all information request frames. See the example below:

The parameter (0x3C) « COM send measures » = 0 so is disable. The converter never send measures frame request but if the information request 0x03 is requested, the converter will send one feedback about measures 1 once.

To have periodically feedback from the converter, send 0x01 in the good parameter. For example, the parameter (0x5C) « COM send warnings » = 1 so is enable.

*Note : For each valid Information Request frame received, the converter will send the requested frame.*

Example:

CAN ID	LENGTH	DATA
02900000	1	06
06	The request is= 06	0x06 = Temperature measures frame is requested

### 9.5.13 Error reset

- Send to converter (write)  
Frame Identifier: **0x05B00000**  
Period of reception: acknowledge errors request  
DLC: 0

Payload: None

Note: On reception of this frame, converter clears error flag and if errors are not present anymore, converter goes from emergency state to standby state.

### 9.5.14 Settings mode

- Send to converter (write)  
Frame Identifier: **0x09700000**  
Period: enter and exit settings mode request  
DLC: 1

Payload:

0

7

Information Request				
BITS	FIELD	UNIT	TYPE	DESCRIPTION
0-7	Settings mode order	-	-	0x00: Exit settings mode order 0x01: Enter settings mode order other values: not used

Example:

CAN ID	LENGTH	DATA
09700000	1	01
01	Settings mode order = 01	0x01 = Enter settings mode order

### 9.5.15 Parameters

Refer to section 10.5 for parameter examples.

For « Parameter Id » fields, refer to section 10.2 for details.

In order to read/update/save parameters, the converter shall be in Settings mode.

- Send to converter (write)  
Frame Identifier: **0x08300000**  
Period: on request  
DLC: 7

Payload:

0	7 8	16	17	55
Action	Parameter ID		Parameter Value	
BITS	FIELD	UNIT	TYPE	DESCRIPTION
0-7	Action	-	-	Defines the action to process of the given parameter: 0x01: Read 0x02: Update 0x03: Save all parameters other values: unused
8-16	Parameter ID	-	0	Refer to section 10.2
17-55	Parameter Value	-	-	Refer to section 10.2 Used only in case of « Update » action

Examples:

- Read action:

CAN ID	LENGTH	DATA
08300000	7	01 3A 00 00 00 00 00
01 3A 00 00 00 00 00	Action = 01	0x01 = Read Action
	Parameter ID = 3A 00	0x0031 = VBus1 Max Parameter
	Parameter Value =	not used with read mode

- Update action:

CAN ID	LENGTH	DATA
08300000	7	02 3A 00 00 C4 09 00
02 3A 00 00 C4 09 00	Action = 02	0x02 = Update Action
	Parameter ID = 3A 00	0x0031 = VBus1 Max Parameter
	Parameter Value = 00 C4 09 00	0x0009C400 = 640 000 mV (640V)

- Save all parameters request:

CAN ID	LENGTH	DATA
08300000	7	03 00 00 00 00 00 00
03	Action = 03	0x03 = Save all parameters Action

Note : Need the first Data in blue to save the parameters only.

#### 9.5.16 All parameters table

Table 23: Frame list from the DCDC (answers frames (from DCDC))

FRAME	DETAILS	BITS	FIELD	UNIT	TYPE	DESCRIPTION
0x03300000	Current measures	0-15	IBus1	0,1 A	-3276.8	Bus1 current value
		16-31	IBus2	0,1 A	-3276.8	Bus2 current value
0x03D00000	Power measures	0-31	PBus1	W	0	Bus1 power value
		32-63	PBus2	W	0	Bus2 power value
0x04700000	Temperature measures	0-7	Temp 1	°C	-50	Temperature 1
		8-15	Temp 2	°C	-50	Temperature 2
0x04800000	Voltages measures	16-23	Temp 3	°C	-50	Temperature 3
		24-31	Temp 4	°C	-50	Temperature 4
0x06F00000	Set-point information	32-39	Temp 5	°C	-50	Temperature 5
		40-47	Temp 6	°C	-50	Temperature 6

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FRAME	DETAILS	BITS	FIELD	UNIT	TYPE	DESCRIPTION
0x06F00000	Regulation information Set-point information	0-7	Software mode	-	-	0x00: Emergency 0x01: Standby 0x02: Running 0x03: Power down 0x04: Settings other values: unused
		8-39	Set point	See description	0	The set point received by the converter is sent back. The unit of the set point depends on the current control type of the converter. Voltage and current set points are expressed in 0.1 A and 0.1 V, power set points are expressed in W.
		40-47	Limitation type	-	-	bit 40: Temperature limitation (0: inactive, 1: active) bit 41: Ramp limitation (0: inactive, 1: active) bit 42: Power limitation (0: inactive, 1: active) other bits: unused
0x07900000	Control information	0-7	Converter mode	-	-	0x01: Bus1 to Bus2 0x02: Bus2 to Bus1 0x03: Bidirectional other values: Converter mode not set
		8-15	Control type	-	-	0x01: vBus2 0x02: vBus1 0x03: iBus1 0x04: iBus2 0x05: pBus2 0x06: pBus1 0x07: vBus2Lim 0x08: vBus1Lim other values: Converter type not set
		16-31	Max current target	0,1 A	0	<ul style="list-style-type: none"> <li>This option is only used when control type is:</li> <li>vBus2Lim (0x07)</li> <li>vBus1Lim (0x08)</li> <li>See mode request frame (0x00500000) chapter 9.5.11, to change the control type.</li> </ul>

**Table 24: Frame list to the DCDC (request frames (from control system to DCDC))**

FRAME	DETAILS	BITS	FIELD	UNIT	TYPE	DESCRIPTION
0x01F00000	Errors	0-31	Critical errors	-	-	More details in chapter « Critical errors »
		32-63	Operating errors	-	-	More details in chapter « Operating errors »
0x55000000	Warnings	0-31	Warnings	-	-	More details in chapter « Warnings »
0x08D000000	Parameter value	0-15	Parameter ID	-	0	Refer to section 10.2
		16-47	Parameter value	-	0	Refer to section 10.2
		48-55	Status	-	-	0x00: Failure
0x00500000	Mode request	0x01:	Converter mode	-	-	0x01: Bus1 to Bus2 0x02: Bus2 to Bus1 0x03: Bidirectional other values: Converter mode not set
		other values: unused	Control type			0x01: vBus2 0x02: vBus1 0x03: iBus1 0x04: iBus2 0x05: pBus2 0x06: pBus1 0x07: vBus2Lim 0x08: vBus1Lim other values: Converter type not set
0x02900000	Information request	0-7	Information request	-	-	0x01: Errors frame request 0x02: Warnings frame request 0x03: Current measures frame request 0x04: Power measures frame request 0x05: Voltage measures frame request 0x06: Temperature measures frame request 0x08: Regulation information request 0x09: Control information request other values: not used
0x09700000	Settings mode	0-7	Settings mode	-	-	0x00: Exit settings mode order 0x01: Enter settings mode order other values: not used

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FRAME	DETAILS	BITS	FIELD	UNIT	TYPE	DESCRIPTION
0x00100000	Control	0-7	Start command	-	-	0x00: Stop order 0x01: Start order other values: unused
		8-39	Setpoint	see Description	0	The set point received by the converter is sent back. The unit of the set point depends on the current control type of the converter. Voltage and current set points are expressed in 0,1 A and 0,1 V, power set points are expressed in W.
		40-55	Max current target	0,1 A	0	<b>This option is only used when control type is :</b> - V High I Lim (0x09) - V Low I Lim (0x0A) <b>See mode request frame (0x00500000) chapter 9.5.11, to change the control type.</b>  To indicate the maximum current value allowed. This field is expressed in 0,1 A.
0x08300000	Parameters	0-7	Action	-	-	Defines the action to process of the given parameter: 0x01: Read 0x02: Update 0x03: Save all parameters other values: unused
		8-23	Parameter ID	-	Unsigned	Refer to section 10.2
		24-55	Parameter value	-	-	Refer to section 10.2 Used only in case of «Update» action
0x05B00000	Error reset	0	-	-	-	Error reset

## 9.6 Sequences and timing

Specific sequences are described below. Only relevant frames and fields are described.

In the following sequences, startup time and stop time parameters are set to their default values :

- startup time = 3s
- stop time = 1s

### 9.6.1 Power ON

Converter sends its first frame on CAN network within 500ms. It is ready to receive and treat frames.

### 9.6.2 Start up

Initial condition : Converter shall be in standby state.

#### 9.6.2.1 Sequence

The following sequence shall be used to start up the converter.

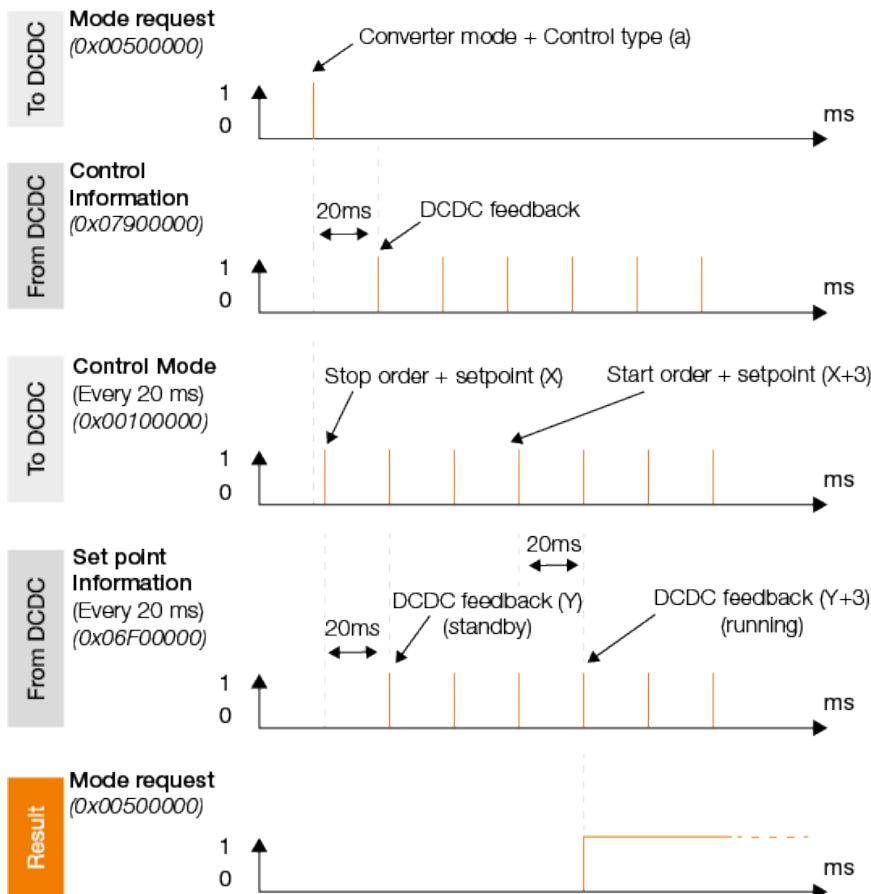
The converter mode (Buck/Boost) and the control type shall be sent to the converter before the start order is given. The frame may or may not be sent periodically, any change in converter mode or the control type will be ignored if the converter is not in standby mode.

Mode request frame and control frame can be set in the same 20ms maximum slot but shall obey the order : Mode request first. The converter send every 20 ms all answers.

Note :

- If your converter has only one mode Buck and only one control type, they are set by default and it is not necessary to send it.
- Setpoint can be updated while operating mode is running.
- Converter has to received and treat stop order command to be able to treat start order command.

*Figure 28: Startup sequence*



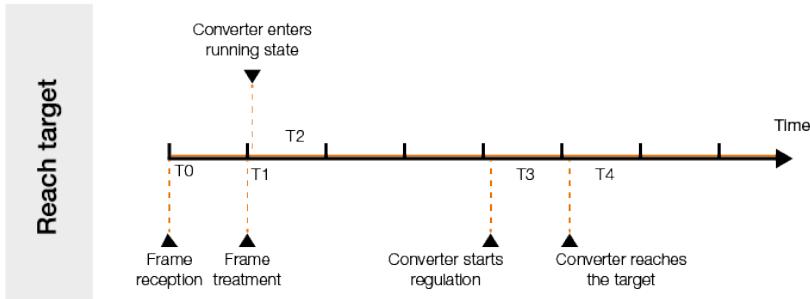
**Table 25: Start-up sequence - frames details**

FRAME & STEP	CONTENT
Mode request (a)	<ul style="list-style-type: none"> <li>• Converter mode: requested converter mode</li> <li>• Control type: requested control type</li> </ul>
Control mode (X)	<ul style="list-style-type: none"> <li>• Start command: stop order = 0</li> <li>• Set point: requested set point</li> </ul>
Control information	<ul style="list-style-type: none"> <li>• Converter mode: answered converter mode</li> <li>• Control type: answered control type</li> </ul>
Set point information (Y)	<ul style="list-style-type: none"> <li>• Operating mode: standby</li> <li>• Set point: answered set point</li> </ul>
Control mode (X+1, X+2)	<ul style="list-style-type: none"> <li>• Start command: stop order = 0</li> <li>• Set point: requested set point</li> </ul>
Set point information (Y+1, Y+2)	<ul style="list-style-type: none"> <li>• Operating mode: standby</li> <li>• Set point: answered set point</li> </ul>
Control mode (X+3)	<ul style="list-style-type: none"> <li>• Start command: start order = 1</li> <li>• Set point: requested set point</li> </ul>
Set point information (Y+3)	<ul style="list-style-type: none"> <li>• Operating mode: running</li> <li>• Set point: answered set point</li> </ul>

#### 9.6.2.2 Delay to reach target after start order reception

T0 - Control (x + 1): frame reception	
T1 - Control (x + 1): frame treatment (within 20ms)	$t0 < t1 \leq t0 + 20\text{ms}$
T2 - Converter enters running state	$t2 = t1 + 1\text{ms}$
T3 - Converter starts regulation	$t3 = t2 + 300\text{ms}$
T4 - Converter reaches the target	$t4 = t3 + \text{start up time}$

**Figure 29: Startup timing**



Delay to reach target with startup time set to 300ms is in range [421 ; 441] ms.  
If start up time is set to its minimum value, 20ms, delay is in range [81 ; 101] ms.

After power OFF/ON, converter needs: power ON delay + 20ms to treat and received stop order frame before being ready to obey first regulation start up sequence.

### 9.6.2.3 Trace extract

**Table 26: Trace extract**

FRAME NAME	TIME		FRAME ADDRESS	DATA SIZE	DATA	COMMENT
Mode request Control	25062,2 25062,2	Rx Rx	500000 100000	2 7	02 05 00 78 00 00 00 00 00 00	Stop order
Measures 1 Errors	25092,7	Tx	3300000	8	00 00 3D 0E 00 00 47 07	
Measures 2	25093	Tx	01F00000	8	00 00 00 00 00 00 00 00	
Measures 3	25093,2	Tx	03D00000	8	4B D0 00 00 00 00 00 00	
Measures 4	25093,5	Tx	4700000	8	E9 FF E9 FF 00 00 FB FF	
Warnings	25093,8	Tx	4800000	8	AD 06 B6 05 00 00 A4 39	
	25094	Tx	5500000	4	00 00 00 00	
Setpoint info. Control info.	25094,3 25094,5	Tx Tx	06F00000 7900000	7 4	01 78 00 00 00 00 01 02 05 00 00	Standby state
Mode request Control	25095,9 25095,9	Rx Rx	500000 100000	2 7	02 05 00 78 00 00 00 00 00	Stop order
Measures 1 Errors	25112,7	Tx	3300000	8	00 00 3D 0E 00 00 47 07	
Measures 2	25113	Tx	01F00000	8	00 00 00 00 00 00 00 00	
Measures 3	25113,2	Tx	03D00000	8	33 D0 00 00 00 00 00 00	
Measures 4	25223,5	Tx	4700000	8	E9 FF E9 FF 00 00 FB FF	
Warnings	25113,8	Tx	4800000	8	AD 06 B6 05 00 00 A4 39	
	25114	Tx	5500000	4	00 00 00 00	
Setpoint info. Control info.	25114,3 25114,5	Tx Tx	06F00000 7900000	7 4	01 78 00 00 00 00 01 02 05 00 00	Standby state
Mode request Control	25123,2 25123,3	Rx Rx	500000 100000	2 7	02 05 01 78 00 00 00 00 00	Start order
Measures 1 Errors	25132,7	Tx	3300000	8	00 00 3D 0E 00 00 47 07	
Measures 2	25133	Tx	01F00000	8	00 00 00 00 00 00 00 00	
Measures 3	25133,2	Tx	03D00000	8	28 D0 00 00 00 00 00 00	
Measures 4	25133,5	Tx	4700000	8	E9 FF E9 FF 00 00 FB FF	
Warnings	25133,8	Tx	4800000	8	AD 06 B5 05 00 00 A4 39	
	25134	Tx	5500000	4	00 00 00 00	
Setpoint info. Control info.	25134,3 25134,5	Tx Tx	06F00000 7900000	7 4	01 78 00 00 00 00 01 02 05 00 00	Standby state
Mode request Control	25151,1 25151,2	Rx Rx	500000 100000	2 7	02 05 01 78 00 00 00 00 00	Start order
Measures 1 Errors	25152,7	Tx	3300000	8	00 00 3D 0E 00 00 47 07	
Measures 2	25153	Tx	01F00000	8	00 00 00 00 00 00 00 00	
Measures 3	25153,2	Tx	03D00000	8	4D D0 00 00 00 00 00 00	
Measures 4	25153,5	Tx	4700000	8	E9 FF E9 FF 00 00 FB FF	
Warnings	25153,8	Tx	4800000	8	AD 06 B6 05 00 00 A4 39	
	25154	Tx	5500000	4	00 00 00 00	
Setpoint info. Control info.	25154,3 25154,5	Tx Tx	06F00000 7900000	7 4	02 78 00 00 00 00 01 02 05 00 00	Running state

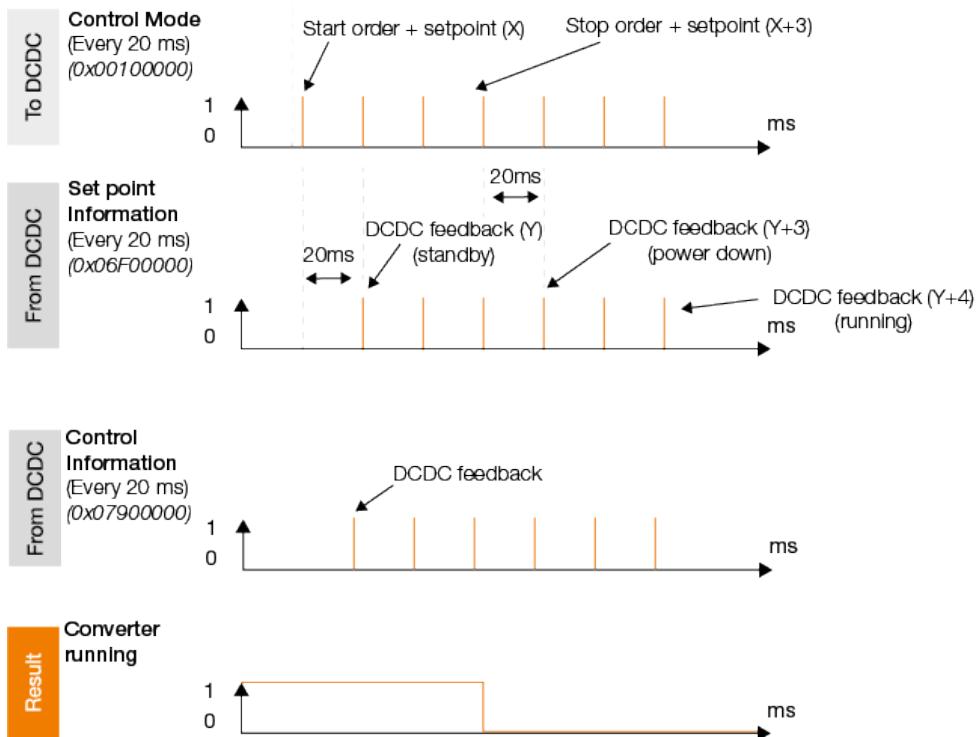
### 9.6.3 Stop sequence

Initial condition: Converter shall be in running state.

#### 9.6.3.1 Sequence

The control frame must still be sent periodically after the stop order was given in order to prevent a Co-misLost error.

Figure 30: Stop sequence



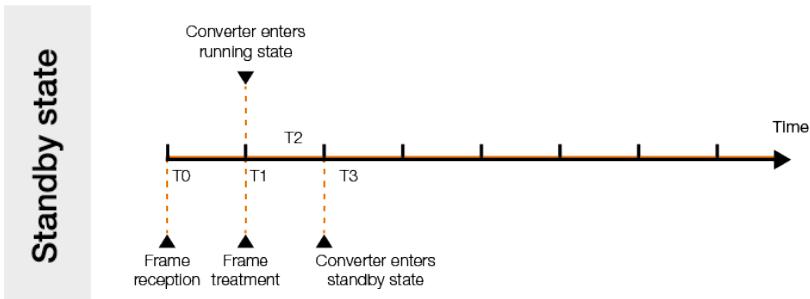
**Table 27: Stop sequence - frame details**

FRAME & STEP	CONTENT
Control Mode (X)	<ul style="list-style-type: none"> <li>Start command = 1: start order</li> <li>Set point: requested set point</li> </ul>
Set point information (Y)	<ul style="list-style-type: none"> <li>Operating mode: running</li> <li>Set point: answered set point</li> </ul>
Control information	<ul style="list-style-type: none"> <li>Converter mode: current converter mode</li> <li>Control type: current control type</li> </ul>
Control Mode (X+1, X+2)	<ul style="list-style-type: none"> <li>Start command = 1: start order</li> <li>Set point: requested set point</li> </ul>
Set point information (Y+1, Y+2)	<ul style="list-style-type: none"> <li>Operating mode: running</li> <li>Set point: answered set point</li> </ul>
Control Mode (X+3)	<ul style="list-style-type: none"> <li>Start command = 0: stop order</li> <li>Set point: requested set point</li> </ul>
Set point information (Y+3)	<ul style="list-style-type: none"> <li>Operating mode: power down</li> <li>Set point: answered set point</li> </ul>
Set point information (Y+4)	<ul style="list-style-type: none"> <li>Operating mode: standby</li> <li>Set point: answered set point</li> </ul>

#### 9.6.3.2 Delay to enter standby state

t0 - Control(x + 1) frame reception	
t1 - Control(x + 1) frame treatment: within 20ms	$t0 < t1 \leq t0 + 20\text{ms}$
t2 - Converter enters power down state	$t2 = t1$
t3 - Converter enters standby state	$t3 = t2 + \text{stop time}$

**Figure 31: Stop Timing**



Delay to enters standby state with stop up time set to 20ms (default value) is in range [20 ; 40] ms.  
Note that stop time default value is equal to stop time minimum value.

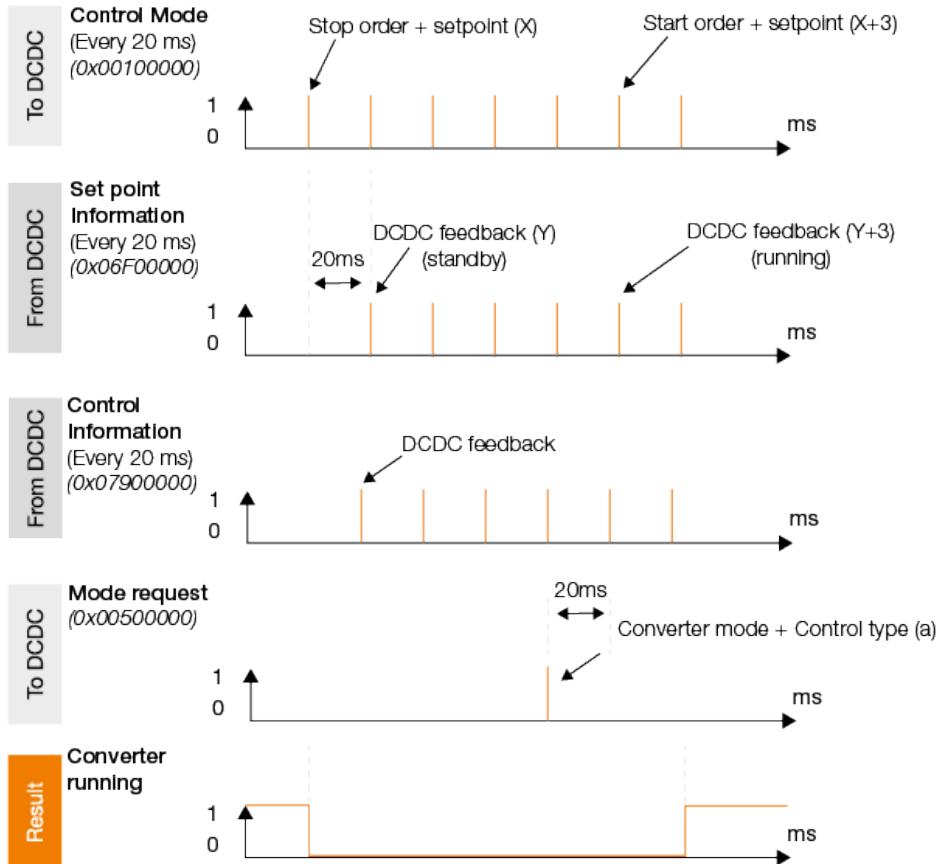
#### 9.6.4 Inverting mode sequence and timing

Initial condition: converter is in mode boost or buck mode and running. Last control frame «start command» field is start order = 1.

Sequence and timing are identical even if converter is working in buck mode first and then boost mode or the opposite.

##### 9.6.4.1 Sequence

*Figure 32: Inverting sequence*



**Table 28 : Inversing sequence - frame details**

FRAME & STEP	CONTENT
Control Mode (X)	<ul style="list-style-type: none"> <li>Start command = 0 stop order</li> <li>Set point: requested set point</li> </ul>
Set point information (Y)	<ul style="list-style-type: none"> <li>Operating mode: standby</li> <li>Set point: answered set point</li> </ul>
Control information	<ul style="list-style-type: none"> <li>Converter mode: current converter mode</li> <li>Control type: current control type</li> </ul>
Mode request (a)	<ul style="list-style-type: none"> <li>Converter mode: requested converter mode a</li> <li>Control type: requested control type a</li> </ul>
Control mode (X+3)	<ul style="list-style-type: none"> <li>Start command = 1 : start order</li> <li>Set point: requested set point</li> </ul>
Set point information (Y+3)	<ul style="list-style-type: none"> <li>Operating mode: running</li> <li>Set point: answered set point</li> </ul>
Control information	<ul style="list-style-type: none"> <li>Converter mode: current converter mode a</li> <li>Control type: current control type a</li> </ul>

Note : The mode request frame to update mode and Control (x + n) frame to send start order can be sent as soon as converter has treated stop order.

#### 9.6.4.2 Timing optimized

In the timing described below, we consider Control (x + n) frame with n =1. Control frame are sent every 100ms to match with converter delay to treat received frames. In this case, timing is optimized and Mode request frame treatment is done while converter is stopping and does not cause additional delay to inverse converter.

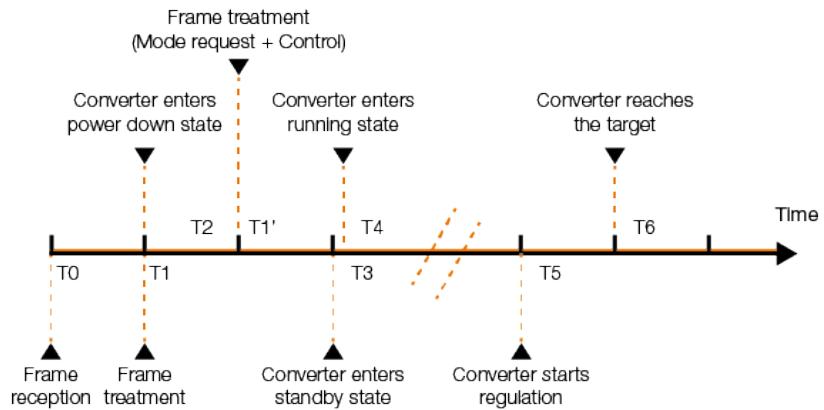
t0 - Control(x) frame reception	
t1 - Control(x) frame treatment: within 20ms	$t0 < t1 \leq t0 + 20\text{ms}$
t2 - Converter enters powerdown state	$t2 = t1$
t1' - Mode Request (a) and Control (x + 1) frame treatment	$t1' = t1 + 20\text{ms}$
t3 - Converter enters standby state	$t3 = t2 + \text{stop time}$
t4 - Converter enters running state	$t4 = t3 + 1\text{ms}$
t5 - Converter starts regulation	$t5 = t4 + 300\text{ms}$
t6 - Converter reaches the target	$t6 = t5 + \text{start up time}$

Considering CAN timing frame emission and reception, start-up time and stop time set to their default value, respectively 300ms and 100ms, delay minimum to inverse mode and reach target is in range [142; 442] ms.

With start-up time and stop time set to their minimum value, respectively 100ms and 100ms, delay minimum to inverse mode and reach target is in range [142; 242] ms.

## Timing optimized

Figure 33 : Inversing mode: optimized timing



### 9.6.5 Error

Initial condition: None

#### 9.6.5.1 Sequence

Figure 34: Error reset and emergency mode

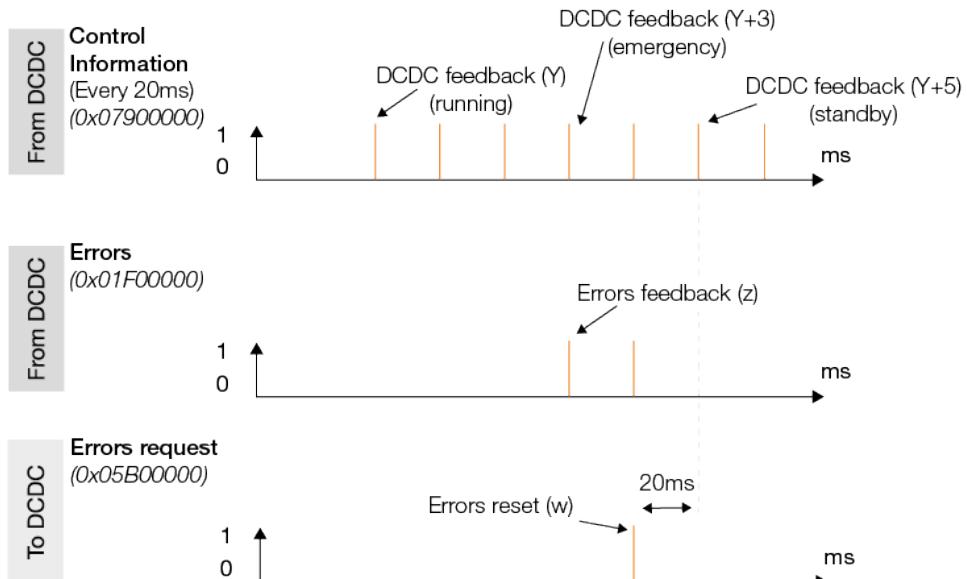


Table 29 : Error reset and emergency mode - frame details

FRAME & STEP	CONTENT
Control information (y)	<ul style="list-style-type: none"> <li>• Converter mode: current converter mode</li> <li>• Control type: current control type</li> </ul>
Control information (y+3)	<ul style="list-style-type: none"> <li>• Converter mode: emergency</li> </ul>
Errors (z)	<ul style="list-style-type: none"> <li>• Error is sent to control System</li> </ul>
Once the error is fixed, the errors can be acknowledged in order to put the converter in standby mode.	
Error reset (w)	<ul style="list-style-type: none"> <li>• There are no fields in the Error reset frame</li> </ul>
Control information (y+5)	<ul style="list-style-type: none"> <li>• Operating mode: standby (the converter has no error)</li> </ul>

#### 9.6.5.2 Delay to enter emergency state if converter is running

t0 - Error appears, converter enters powerdown state	t1 = t0 in case of critical error
t1 - Converter enters emergency state	t1 = t0 + stop time in case of operating error
t2 - Control information (y+1) transmission op mode emergency	t1 < t2 <= t1 + 20ms

Figure 35: Emergency timing in case of critical error

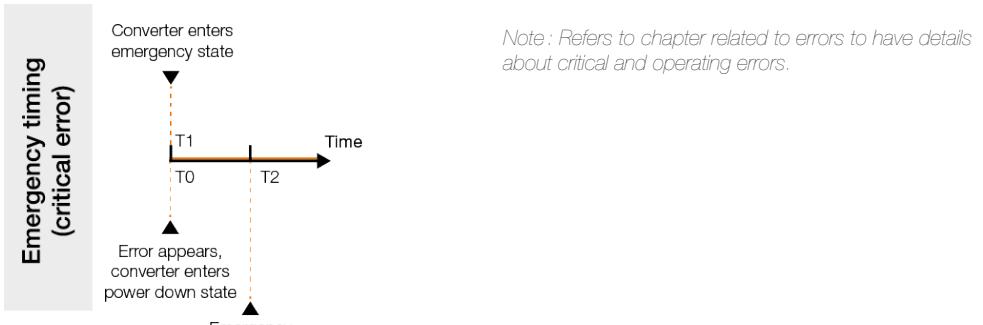
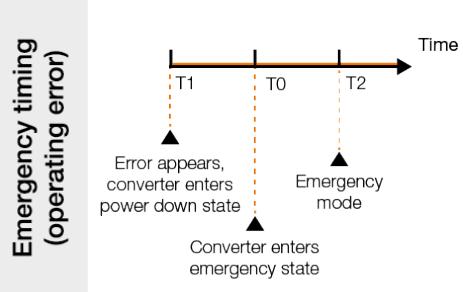


Figure 36: Emergency timing in case of operating error



# 10 PARAMETERS

## 10.1 Definitions

Refer to chapter 8.3.2 for CAN frame detail.

### 10.1.1 Data types

Several data types are defined:

- Unsigned: the parameter is an unsigned number, coded on 32 bits.
- Boolean: the parameter is a Boolean, it can take the value 0 or 1 only and is used to activate or deactivate a specific feature.
- Enumeration: the parameter can take one value, in a set of predefined values. Each value has its own meaning.

### 10.1.2 Access rights

Some parameter can be read only (access right is "r"), some other parameters can be read and written (access right is "rw").

Any attempt to write a value to a read only parameter will lead to a "failure" return code.

### 10.1.3 Using parameters to configure your converter

The converter must be in Settings mode to access parameters.

The parameters give you access to the main DCDC configuration.

When you attempt to change a parameter the DCDC answers with the «parameter Value» frame.

Unless specified (CAN parameters for example), the parameters are effective as soon as you send them. If you don't save them, they will take back their previous value at the next converter start-up.

*Note : If the CAN\_TIMEOUT parameter (0x3A) is 0, the timeout CAN is disabled.*

## 10.2 Parameter list and ID

In settings mode, the following parameters can be accessed.

*Table 25: Parameters description*

**1/3: Description, Identifier**

**2/3: Minimum, Maximum, Unit**

**3/3: Type, Default Value, Access Rights, Needs reboot to be taken into account**

**Table 30: Parameters description (1/3)**

PARAMETER NAME	DESCRIPTION	ID
SW_VERSION	SW version: to be read in BCD format	0x00
HW_VERSION	HW version: to be read in BCD format	0x01
SERIAL_NR	Serial number	0x02
VHIGH_MAX	High side maximum voltage value allowed	0x31
VHIGH_MIN	High side minimum voltage value allowed	0x32
VLOW_MAX	Low side maximum voltage value allowed	0x33
VLOW_MIN	Low side minimum voltage value allowed	0x34
IHIGH_MAX	High side maximum current value allowed	0x35
ILOW_MAX	Low side maximum current value allowed	0x36
CAN_ADDR	Device CAN ID address: corresponds to last byte of CAN identifier field in CAN frame protocol. Permits to connect several DCDC devices on the network	0x39
CAN_TIMEOUT	CAN timeout	0x3A
CAN_BITRATE	CAN bit rate: 0 : corresponds to 500kps 1 : corresponds to 250kps 2 : corresponds to 125kps	0x3B
COM_SEND_MEASURES	Measures frames transmission activation/desactivation	0x3C
COM_SEND_ERRORS	Error frames transmission activation/desactivation	0x3D
COM_SEND_SETPOINT_INFOS	Setpoint information frames transmission activation/desactivation	0x3E
COM_SEND_CONTROL_INFOS	Control information frames transmission activation/desactivation	0x3F
STARTUP_TIME	Delay DCDC uses to reach the target progressively after DCDC has received start order	0x40
STOP_TIME	Delay DCDC uses to reach the target progressively after DCDC has received stop order or operating error	0x41
SETPOINT_CHANGE_STEP	Step used to reach a new target while DCDC is operating (after start-up time has elapsed)	0x42
BOOTLOADER_VERSION	Bootloader Version: to be read in BCD format	0x5B
COM_SEND_WARNING	Warning frame transmission activation/desactivation	0x5C

**Table 30: Parameters description (2/3)**

PARAMETER NAME	MIN	MAX	UNIT
SW_VERSION	0	U32_MAX	-
HW_VERSION	0	U32_MAX	-
SERIAL_NR	0	U32_MAX	-
VHIGH_MAX	VHIGH_MIN	Depends on the product	mV
VHIGH_MIN	Depends on the product	VHIGH_MAX	mV
VLOW_MAX	VLOW_MIN	Depends on the product	mV
VLOW_MIN	Depends on the product	VLOW_MAX	mV
IHIGH_MAX	0	Depends on the product	mV
ILOW_MAX	0	Depends on the product	mV
CAN_ADDR	0	255	-
CAN_TIMEOUT	0	100	0,1s
CAN_BITRATE	0	2	
COM_SEND_MEASURES	0	1	-
COM_SEND_ERRORS	0	1	-
COM_SEND_SETPOINT_INFOS	0	1	-
COM_SEND_CONTROL_INFOS	0	1	-
STARTUP_TIME	1	100	0,1s
STOP_TIME	1	100	0,1s
SETPOINT_CHANGE_STEP	1	S32_MAX	SetpointUnit/100ms i.e 0,1V/0,1s or 0,1A/0,1s or W/0,1s
BOOTLOADER_VERSION	0	U32_MAX	-
COM_SEND_WARNING	0	1	-

**Table 30: Parameters description (3/3)**

PARAMETER NAME	TYPE	DEFAULT VALUE	ACCESS RIGHTS	NEEDS REBOOT TO BE TAKEN INTO ACCOUNT
SW_VERSION	Unsigned	-	r	
HW_VERSION	Unsigned	-	r	
SERIAL_NR	Unsigned	-	r	
VHIGH_MAX	Unsigned	Depends on the product	rw	
VHIGH_MIN	Unsigned	Depends on the product	rw	
VLOW_MAX	Unsigned	Depends on the product	rw	
VLOW_MIN	Unsigned	Depends on the product	rw	
IHIGH_MAX	Unsigned	Depends on the product	rw	
ILOW_MAX	Unsigned	Depends on the product	rw	
CAN_ADDR	Unsigned	0	rw	x
CAN_TIMEOUT	Unsigned	10	rw	x
CAN_BITRATE	Unsigned	0 (corresponds to 500kps)	rw	x
COM_SEND_MEASURES	Boolean	1	rw	
COM_SEND_ERRORS	Boolean	1	rw	
COM_SEND_SETPOINT_INFOS	Boolean	1	rw	
COM_SEND_CONTROL_INFOS	Boolean	1	rw	
STARTUP_TIME	Unsigned	30	rw	
STOP_TIME	Unsigned	10	rw	
SETPOINT_CHANGE_STEP	Unsigned	100	rw	
BOOTLOADER_VERSION	Unsigned	-	r	
COM_SEND_WARNING	Boolean	1	rw	

## 10.3 Parameter description

### 10.3.1 Product identification

A converter can be identified by its “Software version”, its “Hardware version” and its “Serial Number”. These parameters are in read only. The serial number is the same as written on the converter’s type plate.

### 10.3.2 Operating limits

The operating limits can be adjusted thanks to the following parameters:

- V High Max: Maximum V High voltage before triggering VHighMax error.
- V High Min: Minimum V High voltage before triggering VHighMin error.
- V Low Max: Maximum V Low voltage before triggering VLowMax error.
- V Low Min: Minimum V Low voltage before triggering VLowMin error.
- I High Max: Maximum I High current before triggering IHIGHMax error.
- I Low Max: Maximum I Low current before triggering ILowMax error.

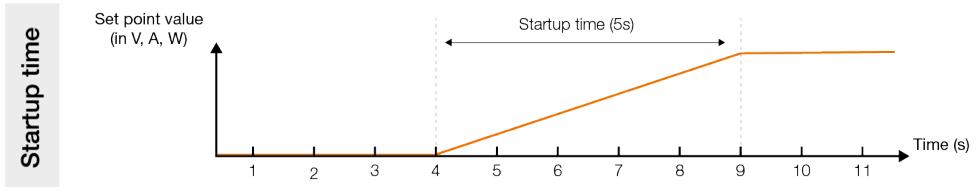
These parameters are expressed in millamps and millivolts.

If a failure status code is returned during a parameter update operation, it probably means the new value sent to the converter is out of the allowed range or the converter is not in settings mode.

### 10.3.3 CAN Configuration

The CAN bit rate is an enumeration which can take the following values:

- 100 Kps
- 250 Kps
- 500 Kps



The “CAN timeout” is expressed in 0.1 seconds, example “CAN Timeout” = 30 = 3 seconds.

The parameters “Send measures”, “Send errors”, “Send warnings”, “Send set point information” and “Send control information” enable or disable the periodic frame sending for measures, errors, set point information and control information frames.

*Note: When the communication parameters are updated, it is necessary to restart the converter so that they are taken into account.*

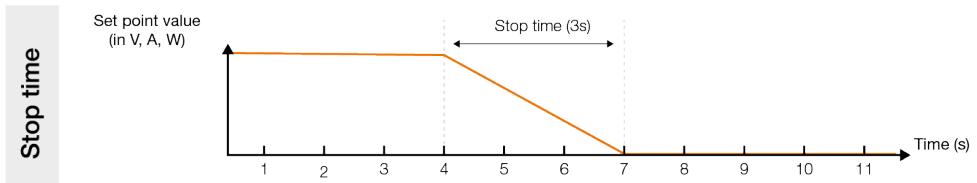
### 10.3.4 Limitations

The “Startup time” and “Stop Time” parameters defines ramp limitation that are applied on the set point during startup and stop operations.

These parameters are expressed in 0.1s:

- Example: “Startup time” = 50 = 5 seconds. (see figure below)

- Example: “Stop time” = 30 = 3 seconds.  
(see figure below)



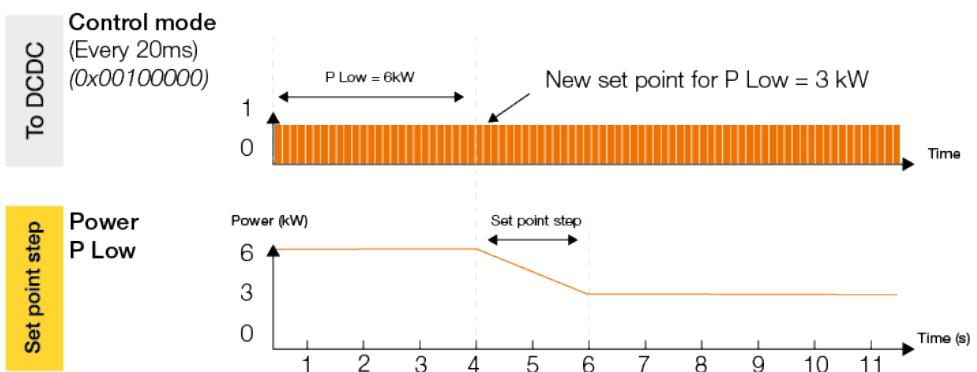
The set point step is the maximum allowed step on the set point for a 20 ms period. The step is expressed in the set point unit per 100 ms. All value are absolute (not negative).

For example:

- P Low control type: “Set point step” = 150 implies the set point evolution is limited to 150 W per 100 ms, so 1.5kW per second. (See figure below)
- I High control type: “Set point step” = 50 implies the set point evolution is limited to 50 \* 0.1 A = 5 amps per 100 ms, so 50 amps per second.
- U High control type: “Set point step” = 500 implies the set point evolution is limited to 500 \* 0.1V = 50V per 100ms, so 500V per second.

Details with P Low control type example :  
(see figure below)

It's possible to change the set point when it needs less power on the system. For this example, the set point is 6 kW and after 4 seconds, a new set point request at 3kw (by control mode frame). Once the new set point done, the converter will have the new value after 2 seconds. The converter take 2 seconds because the converter decrease from 6 kW to 3 kW with 1500 w/s. (this result is due with 150 implies in set point change parameter).



## 10.4 Save operation

After a parameter modification, the parameters must be saved, otherwise their values will be taken into account until the next converter power-off only. When a save operation is executed, all the converter parameters are saved.



Do not stop the auxiliary voltage during the saving (Around 3s). It could corrupt all the microcontroller.

## 10.5 Settings and parameters

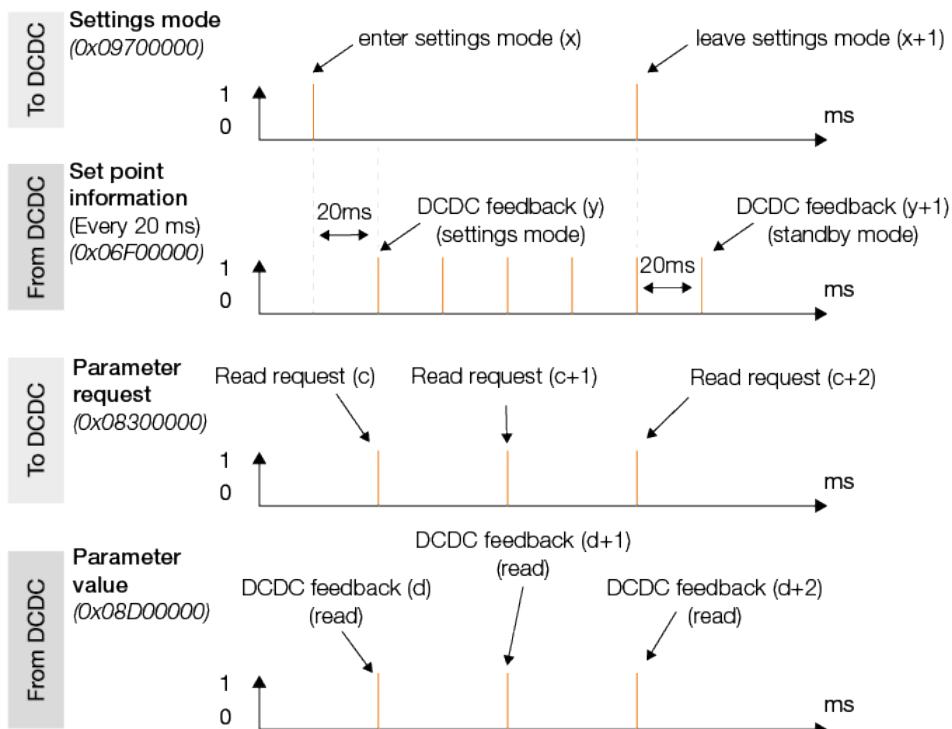
Note : Operation "Save" must be executed at the end of the parametrization, otherwise at next reboot, the updated parameters will take their previous values.

In order to read/update/save parameters, the converter shall be in Settings mode.

**BE CAREFUL:** Do NOT power off the converter while saving is in progress!

Initial condition: Converter shall be in standby state.

Figure 37: Settings mode and parameter operations



**Table 31: Settings mode and parameter operations - frame details**

FRAME & STEP	CONTENT
Settings mode (x)	<ul style="list-style-type: none"> <li>Request: Enter settings mode = 1</li> </ul>
Setpoint information (y)	<ul style="list-style-type: none"> <li>Converter mode: settings mode</li> </ul>
Read parameter operation	
Parameter Request (c)	<ul style="list-style-type: none"> <li>Action Read = 1</li> <li>Parameter ID: ID of the parameter to read</li> <li>Parameter Value: N/A</li> </ul>
Parameter Value (d)	<ul style="list-style-type: none"> <li>Parameter ID: ID of the parameter to read</li> <li>Parameter value: value of the parameter</li> <li>Status: success</li> </ul>
Write parameter operation	
Parameter Request (c+1)	<p>Parameter request:</p> <ul style="list-style-type: none"> <li>Action: Update/Write = 2</li> <li>Parameter ID: ID of the parameter to write</li> <li>Parameter Value: New parameter value</li> </ul>
Parameter Value (d+1)	<p>Parameter value:</p> <ul style="list-style-type: none"> <li>Parameter ID: ID of the parameter to read</li> <li>Parameter Value: actual value of the parameter</li> <li>Status: success</li> </ul>
Save parameters operation	
Parameter Request (c+2)	<p>Parameter request:</p> <ul style="list-style-type: none"> <li>Action : Save = 3</li> <li>Parameter ID: N/A</li> <li>Parameter Value: N/A</li> </ul>
Parameter Value (c+2)	<p>Parameter value:</p> <ul style="list-style-type: none"> <li>Parameter ID : 0xFFFF</li> <li>Parameter Value: N/A</li> <li>Status: success</li> </ul>
Exit parameters operation	
Settings mode (x+1)	<ul style="list-style-type: none"> <li>Request: Enter settings mode = 0</li> </ul>
Setpoint information (y+1)	<ul style="list-style-type: none"> <li>Converter mode: standby mode</li> </ul>

Note: Parameter Request can be "N" sent times while in settings mode.

These are 4 examples to change the different parameters (following parameter list):

**Table 32 : Example of CAN Address parameter change**

FRAME TYPE	ID	FRAME SIZE	DATA	COMMENT
Request	0x09700000	1	0x 01	Enter in settings mode
Answer	0x06F00000	6	0x 04 00 00 00 00 00	Converter passes on settings mode
Request	0x08300000	7	0x 02 39 00 32 00 00 00	Write the new address CAN to 0x32
Answer	0x08D00000	7	0x 39 00 32 00 00 00 01	Converter's answer (to read)
Request	0x8300000	7	0x 03 00 00 00 00 00 00	Save the address value
Answer	0x08D00000	7	0x FF FF 00 00 00 00 01	Converter's answer (to read)
Request	0x09700000	1	0x 00	Leave the settings mode
Answer	0x06F00000	6	0x 01 00 00 00 00 00	The converter enters in standby mode

**Table 33 : Example of speed CAN parameter change**

FRAME TYPE	ID	FRAME SIZE	DATA	COMMENT
Request	0x09700000	1	0x 01	Enter in settings mode
Answer	0x06F00000	6	0x 04 00 00 00 00 00	Converter passes on settings mode
Request	0x08300000	7	0x 02 3B 00 01 00 00 00	Write the new speed CAN to 1
Answer	0x08D00000	7	0x 3B 00 01 00 00 00 01	Converter's answer (to read)
Request	0x8300000	7	0x 03 00 00 00 00 00 00	Save the speed value
Answer	0x08D00000	7	0x FF FF 00 00 00 00 01	Converter's answer (to read)
Request	0x09700000	1	0x 00	Leave the settings mode
Answer	0x06F00000	6	0x 01 00 00 00 00 00	The converter enters in standby mode

**Table 34: Example of startup time parameter change**

FRAME TYPE	ID	FRAME SIZE	DATA	COMMENT
Request	0x09700000	1	0x 01	Enter in settings mode
Answer	0x06F00000	6	0x 04 00 00 00 00 00	Converter passes on settings mode
Request	0x08300000	7	0x 02 40 00 50 00 00 00	Write the new time CAN to 80 ms
Answer	0x08D00000	7	0x 40 00 50 00 00 00 01	Converter's answer (to read)
Request	0x8300000	7	0x 03 00 00 00 00 00 00	Save the time value
Answer	0x08D00000	7	0x FF FF 00 00 00 00 01	Converter's answer (to read)
Request	0x09700000	1	0x 00	Leave the settings mode
Answer	0x06F00000	6	0x 01 00 00 00 00 00	The converter enters in standby mode

**Table 35: Example of VHigh max parameter change**

FRAME TYPE	ID	FRAME SIZE	DATA	COMMENT
Request	0x09700000	1	0x 01	Enter in settings mode
Answer	0x06F00000	6	0x 04 00 00 00 00 00	Converter passes on settings mode
Request	0x08300000	7	0x 01 31 00 00 00 00 00	Request to read the actual VHigh max value
Answer	0x08D00000	7	0x 31 00 10 EB 09 00 01	Converter's answer: 650 000 = 650V
Request	0x08300000	7	0x 02 31 00 00 C4 09 00	Write the new VHigh max to 640V
Answer	0x08D00000	7	0x 31 00 00 C4 09 00 01	Converter's answer: 640 000 = 640V
Request	0x8300000	7	0x 03 00 00 00 00 00 00	Save the voltage value
Answer	0x08D00000	7	0x FF FF 00 00 00 00 01	Converter's answer (to read)
Request	0x09700000	1	0x 00	Leave the settings mode
Answer	0x06F00000	6	0x 01 00 00 00 00 00	The converter enters in standby mode

# 11 USE CASES

Note : Find the application note on the [Tame-Power](#) website with more details.

- HV Battery-to-LV Battery

The converter can be used with Battery application in buck mode to battery. This typical application is for a electrical vehicle. The converter transfers the power from the high voltage battery (800V) to the low voltage battery (24V).

*Figure 38: Schematic buck application example*



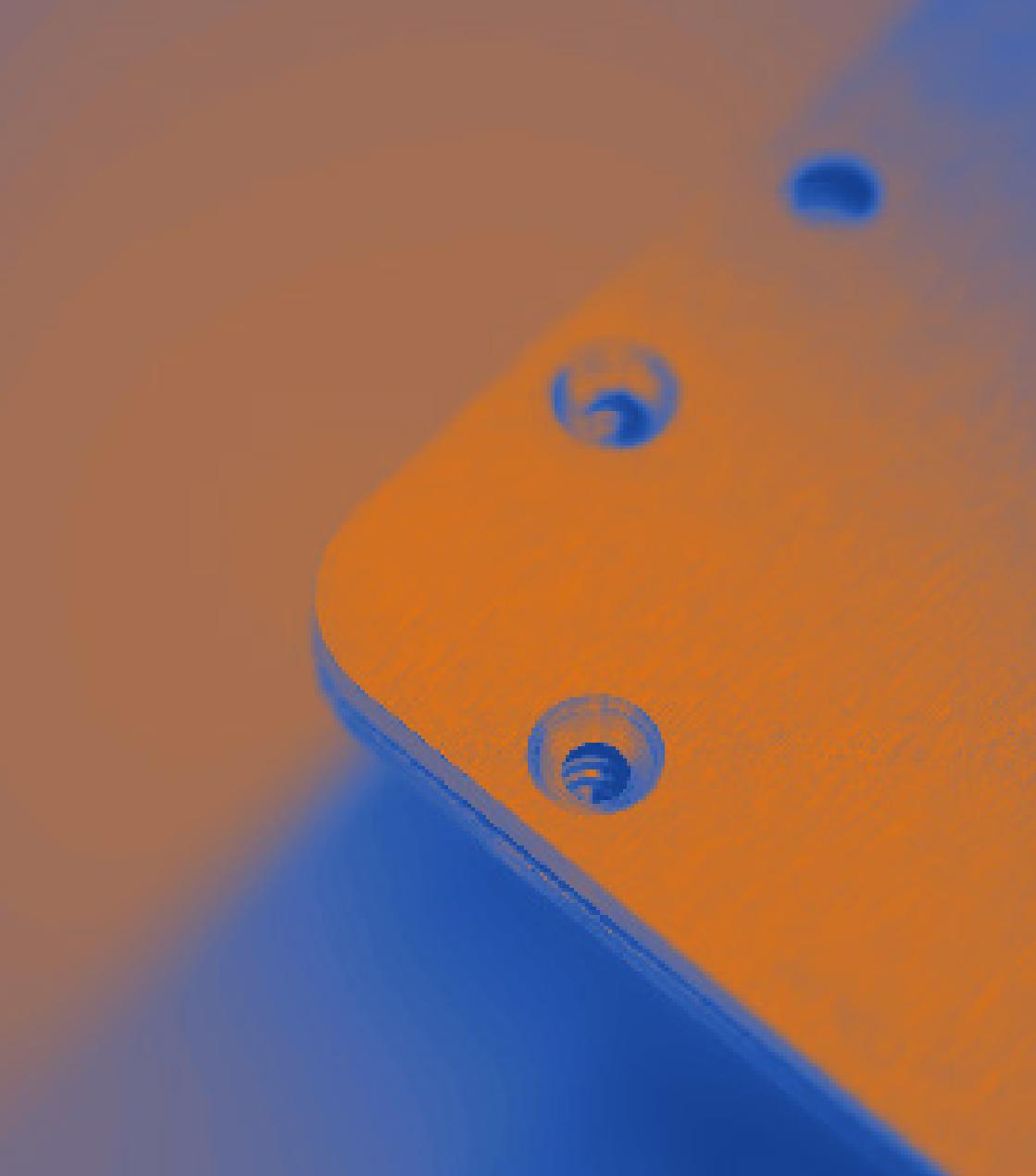
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## DCDC CONVERTER USER MANUAL - CISO SERIES - Isolated

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